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HEYKIM NABI "COSMOS'"

MEMO

FOR

THINKING MEN.

"I had no connexion either in the press or in public life; I incurred the accustomed penalty of being looked upon as a Visionary, and what I knew to be facts were treated as paradoxes."

"What you don't grasp is wholly lost to you!
What you don't reckon, think you, can't be true;
What you don't weigh, it has no weight, alas!
What you don't coin, you're sure it will not pass!"

"Desipiunt omnes æque ac tu."

"And they who call you fool, with equal claim
May plead an ample title to the same."

Hor. 1, 2, Sat. 3.

*"Nimirum insanus paucis videatur; eo quod
Maxima pars hominum morbo jactatur eodem."*

"When all are mad, where all are alike opprest,
Who can discern one madman from the rest."

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[a]

THE CREATION:

AFTER THE ALLEGORY OF THE MOSAIC COSMOGONY.

BY NABI COSMOS.

"Are God and Nature, then, at strife,
So careful of the type she seems,
So careless, then, of single life,
So careful of the type,—but No!
From scarped cliff and quarried stone,
She cries a thousand types are gone;
I care for nothing,—all shall go."

"When the gude Laird was making Adam,
E'en then the Grant clan was as thick
As the heather on yon moor."—GRANT.

ONE night in the month of *Temootz*—July, after making my *du'a etmek*, or prayers, and partaking of my *hatschieh*, or *hesh-sheiste*, I ascended to the *dam*, or roof of my house, and, falling into a pleasant sleep, I had the following vision:—

"I was in a dismal dreary desert, amid a chaotic confusion, with "crags, knolls, and mounds confusedly hurled,"

[a] The words in Genesis,—"God made the firmament," the Hebrew pl. has *Shamaim*, meaning the higher regions.

Again the *expansion, heaven,* is (fire-water) a compound of fire and water.

and black, horrid darkness surrounding me, when I felt a gentle cold touch on my shoulder, and a small still voice whispered in my ear, "'*Ana Allah alam*,' 'I am the most wise God'—'*Allah Taala*,' 'the most high God'—'*Ana li minni*,' 'to me and from me,' arise son of the *Peighamber*, Prophet, and listen to the God of thy father, the Seer." '*Emrallalin*,' replied I. Allah then said, 'I, the *Elohim*,[b] *Bugwan*, or 'The Undetermined,' before me, things create were[f] none, save things eternal, who knew thee before I formed thee in the belly, and before thou camest forth out of the womb; I sanctified thee, and I ordained thee a prophet unto the nations. I shall now speak to thee, not in dark speeches, but by *visions*, and explain the hidden mysteries of Nature, even before moving matter[c] existed, or the foundations of the deep were formed, or the Earth had been modelled into its present form, and *thousands* of *aions* and kalpas had passed

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Bodies formerly amassed were expanded by heat, and formed into a firmament or expansion.

Modern Confucianism, according to *Choo-he*, is called 'Feng-shui,' *wind* and *water*; the first we cannot comprehend, the second we cannot grasp.

The universe, according to numerical proportion, is called "Su."

The Chinese maintain an abstract principle or monad, called absolute nothing, which evolved of itself the "great absolute." When it first moved, its breath or vital energy congealing produced the great "male principle;" when it moved to its uttermost, it rested and formed the "female principle."

The animating energy moving both the two principles is K'é (Chi) "breath of nature."

The actions of these powers are strictly immutable. These laws of nature are "Li."

"These principles are hidden, and only revealed through forms and outlines of physical science, and are called 'Yong.'"

[a] Sir Wm. Thompson gives ten millions, while Sir C. Lyell gives 300 to 500 millions of years as the probable duration of life on the globe. "Fifty to one hundred millions" is the "Age of this Earth."—GEOGRAPHICAL MAGAZINE, Feb., 1877

[a] William Law, in England, a hundred and fifty years ago, wrote :—" All Nature is itself a birth from God. Creation out of

away.[a] Know, then, son of Man, that at that *(muddet)* time the *Ishites* did not exist, nor yet had I caused the quivering rays of Sol [d] to fall on thy maternal mother Earth, and bring forth the *Hadamah*, or, *Adamites*, of whom I spoke through the mouth of my prophet

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nothing is a fiction of theology. So far is Nature from being out of nothing, that it is the manifestation of that in God which before was not manifest; and as Nature is the manifestation of God, so all creatures are the manifestations of the powers of Nature. . . . . Properly and strictly speaking, nothing can begin to be. The beginning of everything is nothing more than its beginning in a new state," or, in other words, a form of evolution which we denominate organic life.

b "There is but one, though the poets call him by many names. They call him *Indra, Nitra, Varuna, Agni*; then he is the winged *Garutmut*. That which is, and is one—the wise in diverse manners." (RIG-VEDA, i, 164.)

c In Genesis i. 2, when God began to work upon an earth already in existence we find it all in confusion, "without form and void." We know, however, that "God is not the author of confusion" (1 Cor. xiv. 33), and a comparison of this passage in Genesis with Isaiah xlv. 18—"He created it not in vain, He formed it to be inhabited," and Jeremiah iv. 23, wherein judgment is seen to reduce it to a condition similar to that in which we find it in Genesis i. 2, will clearly indicate that such was not the state in which it came from the hand of God, but these various passages suggest a perfect thing (over which judgment had at some time passed), a partial ruin, and a restoration.

c The ring system of Saturn is suggestive of "matter not completely used up."—(PROCTOR.)

c If all globes were formed by "one act of creation," we must have a cause for the differences; and then, if other planets which were cast off before the earth are still masses of fire, it might be necessary to explain why this earth, composed of similar materials, belonging to the same centre, and cast off in exactly the same way, ever became cool enough to admit upon it vegetation or life?"—(MALET.)

d "We eat and drink the sunshine: your blood is warm."

"Man nourished in embryo by dust, born from our womb, fed on our food, and possessing a brother kin with life and electricity," first existing in the sunshine, originating from a volcano, and, Phœnix-like, springing from its ashes: his power over Nature was formerly in the tea-kettle and in the toy-magnet.

Moses.[e] I had not then made the coral-worm to toil in the treacherous main, nor the silkworm to weave its cocoon, nor even the *monas atomas* to develop itself, or the mountains to be brought forth from the briny abyss. While musing on these words, Allah disappeared from my optic vision. I gazed wistfully into space, and saw as if a finger writing with electric fire on stone these words, [f] "God manifested in Man." I reverently placed my right hand on my breast, and exclaimed, "May the peace and shadow of Allah, the Perfection,[ee] protect and rest on me," and immediately I was entranced, and exclaimed—

> "Hide me from my deep emotion,
> O thou wondrous Mother—Age."

As if impelled forward by some magnetic force, I beheld (but not as Moses the Seer did, with the eye of faith) a

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[d] We contain all the colored vapours of the rainbow, are seen in the "Aurora Burealis," in the falling meteor, in solutions which return to us as crystals—

> "Pure crystals had been made by fire:
> Fire made he mountains higher."

and in the water-spring that leaves its solution as sediments in its basin, or on its brink. We are a mechanical power existing in light and heat. We may live a dozen times and reappear in another form—even in a snow-flake—

> "The minutest drop of rain
> That hangeth in its thinnest cloud
> But flowed in human veins."

[d] "Dust thou art," and yet the cosmical dust forms part of our reason.—we form part of Nature's and *Sub-Commander Circumstances* grand plan of mutual accommodation.

[d] If light was the cause of attraction, at Creation gravitation was taking place through space, without a guide. "Space being dark," says Professor Dawson, "gravitation then might have been aimless and endless."

[d] Heat and light cause attraction in the vegetable world, while attraction and heat in animals is caused by consumption of vegetation.

[d] "The only known Cosmical law-giver is the Sun."—(MALET.)

[e] "A person," says Prof. Huxley, "who is not a Hebrew scholar, can only stand aside and admire the marvellous flexibility of language which admits of such diverse interpretations." The term "Mosaic," in reference to the same doctrine, he also

considers objectionable, because "we are now assured upon the authority of the highest critics, and even dignitaries of the Church, that there is no evidence that Moses wrote the book of Genesis, or knew anything about it."

" How long the human mind is to be kept in the trammel of doubt and uncertainty as to the finding and knowing of the true God depends to a considerable degree upon its own exertions. After thousands of years, man's mind, with regard to its conceptions of the *All-Intelligent*, is either swayed or cramped by ecclesiastical statutes into absurd caricatures, which aim to pull down the *All-Intelligent* to the level of a miserable human likeness.

" If the Being is All-Infinite, as many assert, it then would be impossible for any mind to form a conception of that which is said to be infinite.

" Not only does the greater part of the All-Intelligent's immaterial substance, in the shape of *ordinate cosmolinx* and their lineïts, traverse the whole extent of the universe, but they traverse, also, all matter, however compact and solid, the matter may be (the monits excepted)—all bodies of inanimate nature, as well as those of organised beings.

" They penetrate the very heart of man and its most hidden recesses. They move within us, across us, on all sides of us; in fact we may say, within these streams of cosmolinæ—within this soul-substance of the *All-Intelligent*—we live, and move, and have our being.

" Many persons talk of an *Omnipotent* Intelligence, to which word we demur. Had *Potent* been used, it would be understood. The *All-Intelligent* cannot immediately operate upon monits of matter. It can operate only (by means of the power of Synduction belonging to its macrocosmic soul or convolution) upon free lineïts by changing their direction, and upon the ordinate cosmolinæ by setting them into vibration. It is obliged, in a great measure, to shape its own course of action according to circumstances which may be brought about by the antagonistic action of *Versatile* Activity; hence the All-Intelligent cannot be omnipotent in the widest meaning of the word.

" The framing or creating of matter has not been accomplished by the *All-Intelligent*.

" Making matter was the work of the versatile-inclined lineïts in striving to preserve the independence of their Versatile Activity.

" The Defects and Deformities of existing things and beings, or their vicious dispositions and imperfect condition must not be considered as the work of the All-Intelligent. Myriads of counter-operations, traceable to the monit's Versatile Activities, indi-

great abyss at my feet: visible, black, and horrid darkness was brooding on chaos!

[gg] Cold, dark, and silent, yet quivering throughout its whole length, breadth, and depth, under the efforts of the two contending power-parties in the struggle for the ascendency, lay the *linearium*[g] of the world, and, what Moses would say, an immaterial[h] orb. Throughout there existed a condition of unstable equilibrium. It showed no

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rectly take part in determining and shaping the handiwork of Nature.

[ee] The more mental functions of the All-Intelligent are to stir and set into vibration—to influence and animate such as are inclined to Its own, and apt to correspond to such vibrations.

[f] In our system we have the poison of gnats, odor of flowers, sweet acids and bitter. We, again, have been heard in thunder and felt in lightning; we have moved oceans and shaken continents; we have excelled light and rotated the Earth's axis; our origin and relations are god-like—"He has become as one of us"—and man comprehends not our origin.

[f] When our energy and vitality, in fact life, disappears, it then only changes its form and puts on a new face. On every hand we are surrounded by invisible forces and intelligences, where, "if you look for them you cannot see them. Identified with the substance of all things they cannot be separated from it. Their coming cannot be calculated."—(Confucius.)

[f] "Did there not pass over man a long space of time during which he was a thing not worthy of remembrance. Verily we have created man of the mingled seed of both sexes.—Koran, cap. lxxvi.

[gg] La Place defines Inertia as "that property of matter by which it (matter) tends to retain its state whether in motion or at rest." Now, a tendency to retain or to effect anything indicates an active power at the bottom of the tendency. But how can philosophers who thus recognize in "inertia" an active *power*, contend that matter is inert? for inertia means inactivity.

Again, in the one case the same "vis inertiæ" is said to retain a body in the place it occupies; in the other case the same "vis inertia" is expected to do the very opposite, viz., to make that same body *change* its position continually from one place to another, and whether in a straight line or not in a straight line, it is nevertheless change of place.

[g] *Linearium* is the name given to the totality of the universal, all traversing cosmolinæ considered collectively as a me-

sign of coursing life and busy action. No gravitation, no light, no heat, no electricity, nor translatory motions existed; all was quivering and pulsating ready to start into action. I then discerned the first act of conflict, by an attack upon the lineïts [h] of the *cosmolinæ* [i] by the monits of matter to destroy the connection of the former, motion in all its varied modes — light, heat, electricity, gravitation—immediately began; monits, [j] or indivisible atoms, *i.e.*, minutest part of a power-point, assumed versatile [k] activity, revolving round their axes, holding positive and negative states to each other, and instantaneously changing every moment the inclination of their

dium—the space—filling cosmical web or weft within the circumference of the physical universe.

The propagation of light is effected under the name of linearium.

[g] " *De nihilo nihilum, in nihilum nil posse reverti* "—

" Out of nothing nothing can be brought,
And that which is can ne'er be turned to nought."

[h] The *Lineït* was the great desideratum felt by Locke when he said, " Could the mind come to so small a part of extension or duration as excluded *divisibility*, that would be, as it were, the indivisible unit or idea, by repetition of which it would make its more enlarged ideas, extension and duration.

The lineït is the most primitive and simple substantive of extension, determined by and consisting of two confronting and reciprocally operating power-points, permanently holding each other coupled in such a manner as to effectually resist any change of distance between them. The lineït has extension of only one dimension. " Even extension without solidity," meaning extension in less than three dimensions, " may," according to Dr. Watts, " be substantial enough to *subsist by itself,* and to deserve the honor of the name of substance."

Let us, in imagination, dissolve and dissever all the different groupings and compounds of matter in the universe, and they will yield monits. Next dissever these monits into their constituents, and we shall have nothing left but forces, in the shape of lineïts, each one consisting of two power-points; so that after all, there remains as the constituent principle of the web and weft of the universe nothing but couplets of power-points. These power couplets are the ultimate real entities, the lineïts.

[i] *Cosmolinæ* are continuous force-lines of indefinite length, traversing the universe, and are composed of lineïts joined end to end.

i "Nihil est alind magnum quam multa minuta."—(VET. AUCT.)

j Monit is the minutest, most ultimate number of diverging points, permanently joined with one of their ends in one common point, standing in the shape of rays or radii in every direction all round this point, as is seen when fine steel-sand is attracted at the point of the magnet, and rotating perpetually about an axis.

The monit most effectually resists penetration as well as separation, and it cannot be divided without being destroyed in its very nature.

k *Versatile Activity.*—The monits of matter and certain lineïts called versatile lineïts, possess a restlessly stirring power, endeavouring and being able to make the monits rotate, and the lineïts it dwells in to change position continually, not only rotatory, but also vibratory.

k Versatile activity consists in an effort-exerting power accessory to each of the two power-points composing the lineït, which power exerts itself to turn away or flee from its companion. This fleeing motion cannot be more fully executed in any other way but in the turning of each point around the other.

k Bacon has defined this versatile or rotatory motion of bodies in the following words :—" It seems to flow from a natural desire of the body which moves, only that it may move, and follow itself, and seek its own embraces, and excite its own nature, and enjoy it, and exercise itself in its proper operation." He thinks that "it would argue levity and inexperience in a philosopher to require or imagine a cause for the last and positive power and law of nature, as much as it would argue levity and inexperience not to demand a cause in those laws and phenomena that are subordinate."

k There cannot be any cause for the most ultimate and most simple principle in nature, viz., for the power-points and for their effort and action upon each other, for there is a certain real limit in nature.

Faraday, in speaking about atoms, says, " To my mind, the nucleus vanishes, and the substance consists of power."

If you then ask me what is power, I reply with Reid, that " a power is a thing so much of its own kind, and so simple in its nature, as to admit of no logical definition." " Every act or operation supposes an efficient power that acts."

No power-point can act, and hence cannot exist, if it has no other power-point to act upon. For to act or exercise a power on nothing is a contradiction.

We have above stated that two power-points form a lineït;

axis of motion. The ether fluid monits oscillated longitudinally, while occasionally a transverse wavy motion was seen; polarized [m] lineïts, struck off incessantly within the aggregates of matter, were consolidated together to form orbs of shining stars.

At the time of the clashing and striking off of the monits, [n] magnetic streams were sent forth from all the celestial bodies, and intense hidden heat, which lay concealed between the interstices of atoms, was disengaged and began to pervade the Universe; and an electro-luminous organism [c] undulated floods of light tangentically.

> "In tracts of fluent heat all spheres began,
> And grew to seeming random forms—
> The seeming prey of cyclic storms—
> Till at the last arose the man."
>
> "Rolling planet, flaming sun,
> Stand in noble man complete."—S. JOHNSON.

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and as an atom is considered a unit of *matter*, so is the lineït to be considered the unit of force, and power-point the unit of *power*.

k Reid says that he "is not able to form a conception how power can be exerted without a will." In reply, I may state, the power lineïts strive to win their end not by means of a free, conscious activity, but by acting with an unconscious will and effort.

m That part of the cosmolinea's extremity which happens to be next to and in contact with the equatorial belt of the rotatory monit, will be *struck off* by the *free end* of the whirling monit's radii, with the co-operation of the inner effort and power of lineïts to join each other's end, so as to compose a continuous straight line, and to re-assume it if disturbed; thereby disjoined from the length of the cosmolinea, and in the shape of a lineït, that is the smallest linea-fragment, flung aside in a tangential direction. The lineït thus struck off we designate a detached or *polarized lineït*, because we suppose it to have polarity, from its anterior end having been touched and operated upon by the monit's radius, while its posterior end was operated upon by the cosmolinea. The pole touched by the monit's radius we call the positive pole.

m As the flung-off or detached polarized lineïts are versatile in only one of their ends, and in other respects passive, they may also by heat, especially by radiated heat, be driven forward, until at last they are bound to arrive, in company with heat, at the circumference of the universe. It may be well said that there is no heat quite clear of detached polarised lineïts, and that all the

beams of heat traversing space are accompanied by an abundance of lineïts. Now, in these polarized lineïts we feel we have found the elementary essence or principle of both electricity and magnetism, manifesting itself to our senses in the streams of the so-called electric and magnetic fluids. It also seems very probable that two polarized lineïts, tending with their versatile ends in opposite directions, by uniting the positive pole of each with the negative pole of the other, may be converted into a neutral electro-lineït or couplet, acting like heat, which, however, is liable at any time to be disunited again.

m Tyndal says of lines of force that the "lines of magnetic force are continually before his eyes; by their aid he colligates his facts, and through the inspiration derived from them he vastly expands the boundaries of our experimental knowledge. The beauty and exactitude of the results of this investigation are extraordinary. I cannot help thinking while I dwell upon them that this discovery of magneto-electricity is the greatest experimental result ever obtained by an investigator."—TYNDALL.

m Faraday was forced to the conviction of the *existence* of force-lines, as entities physically subsisting *per se*, so that they may be substantial enough to be shaken by molecular power, and thus to serve (instead of the universal ether assumed by most physicists) as vibrating medium; and that among these physical lines he recognised the lines of gravitating force.

He considered such lines "as wonderful aids in the hands of the experimentalist and mathematician."

c Encke found his comet accelerated about two years at each revolution, and that this occurred as though produced by a resisting medium. The distance will shorten the periodical time of a comet: it nevertheless depends on planetary laws. If one force is diminished the other will be increased in exactly the same ratio.

The density of the ether will be nearest the Sun.

Norman Lockyear talks of matter many times lighter than hydrogen; and Professor Crookes tells the Royal Society of ultra-gaseus matter in connection with electricity. Dr. Babbit's researches point back of electricity to a dual unity—an element and a principle of motion together. Chavee, a French physicist, says, "No fact in physics, chemistry, or mechanics contravenes the theory of an electro-luminous organism." Spencer, in speaking of the etherial matter, says, "There is a force at work with which it (Earth) is held must at last bring the Earth into the Sun. This force is the resistance of the "etherial medium.'"

With regard to the purely hypothetical "ether" so generally and confidently assumed as really existing, a recent writer says, "The purely hypothetical 'ether' (which is nothing but a clothes-horse for all the insoluble difficulties presented by the pheno-

mena of sensible material existence—a fagot of occult qualities and *principia expressiva*—whose *role* in the material world at large is analogous to the part played by the *aura vitalis*, and similar phantasms in the organic world.")—(STALLO)

n Monits do most generally exist arranged in little groups, called molecules; they may, however, in the hottest part of the Sun be isolated.

"The fate of Democrits' theory of atoms, which was long neglected on account of its remoteness from common notions, was unsettled and nearly overthrown by the arguments of other philosophies which came nearer the vulgar comprehension."—(BACON.)

"And assuredly, since the words or vocables of all languages in all their prodigious variety are compounded of a few simple characters, so in like manner are the agencies and powers of the universe composed of a few primary properties or original springs of motion. And disgraceful would it be to mankind to have studied with such pertinacious exactness the tinkle of their own utterance, but to have been in the tongue of nature unlearned."—(BACON.)

An atom has extension in three dimensions, or rather offers resistance in three dimensions, corresponding to that of a solid in geometry, viz., Extension, Rotation, Inpenetrability. The latter has ideal extension in three dimensions, the former physical solid (atom) has real extension *sustained by active resistance* in three dimensions.

In the atom we have extension or resistance in one dimension, which at once leads us to the conception of a line; in geometry to a mathematical line, and in physics to the physical line, which latter sustains its extension by *active resistance* in one dimension.

Lines in physics can be divided, but the shortest one which possibly can exist, is that which lies between two power-points, and would yield nothing but two power-points. This couplet is proposed to be called LINEIT; and as an atom is considered a unit of *matter*, so is the lineït to be considered the unit of *force*, and power-points the unit of *power*.

A point in geometry has position but not magnitude, and more than one point may be in the same position, as regards to the end-point of lineïts, that is, another position outside the first one.

A *point of power* can have no single existence of itself; in our explanation I do not mean inability to act, but an ability that continually and unremittingly does exert itself by effectually acting *upon* or *against* some other more simple body. This other simple object, however, can be nothing else but another power-

Forked, curved, zigzagged, lambent flames licked the fluid, hissing, boiling matter, and fiery meteors rolled like mighty billows of the ocean, and "whirlpools of flame were vomited towards Heaven." And each burning element revealed itself to my eye in different pitch of color.

Through fear and dread agony I was rivetted to the spot; the marrow of my bones was as if frozen, my nervous system paralysed, the feelings of my mind frenzied and harrowed from their source, my eyes starting from their sockets, my blood curdled and dried up in its veins, and my form became as a lumpless mass of matter immersed in water, and yet I remained unharmed

"Amidst" this "crash of Matter"
And this "wreck of Worlds."

The war of mighty tempests,° and the low and ever-increasing roar of fierce and untamable elements, assailed my deadened ears; all pointed out to my dim vision the groans and throes of pent-up agony, as if the death-struggle of the God of Nature was taking place.

"Dire was the noise of conflict,
O'erhead and beneath the dismal hiss of fiery darts in
flaming vollies flew;
All heaven resounded, and had earth been then,
All earth had then to her centre shook."

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point at infintesimal distance. The power-point can only exist in reciprocal action with another power-point, either as constituent power-points determining each other, so as to form an indissoluble couplet, or else as accessory power-points dwelling in such a couplet, and acting upon one of its points.

The whole energy in the universe consists in the three *acting powers* of bringing together, of turning away, and of making parallel; and all the numberless changes and motions performed therein are brought about by the same three powers acting upon the lineït, which latter they use as their substratum.

End-unition (the act of power or uniting—Wiseman), *Synduction*, and *Versatile Activity*, called by Faraday "centres of force," are properly not forces in the ordinary acceptation of the word, such as heat, gravitation, etc.; they are effort-exerting powers—an active, though unconsciously acting tendency exerted to some definite simple purpose, not subject to the laws of convertibility, and rather the cause than the correlatives of the forces just enumerated.

The lightning flashed elliptical curves on the fluid matter, and huge thunderbolts repeatedly rolled in every direction over the intermingled groaning chaos. The sounds and din of noise abounded; overhead a sheet of vivid colored flames descended, as if reaching from the milky galaxy, disclosing a wide and fearful expanse, "wrapping æther in a blaze: enlarging, deepening, mingling, peel on peel, crushed horrible, convulsing Heaven and fluid Earth." I look down and behold a hell on earth, before me spread a fiery ocean, bounded only by a fiery sky; its lightning-capped billows heave heavily; and, now, as if mad, they leap in fury to the ruddy clouds that lower above them, hissing, swelling, boiling like a huge cauldron, while dense vapors rise from its agitated surface. Its air is hotter than a volcano's breath, and more deadly than the dread Simoom. Flakes of solid matter float on the molten sea, which rose and fell in flaming [oo] tides towards a hidden and benighted moon. The flakes cake together, and cover the ball with a solid sheet, which was upraised and cracked by tidal waves beneath, like thin ice in the Arctic Ocean.

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o The cause of winds at Creation was by evaporation causing expansion in the sunlight, and contraction in the darkness; with these two actions by day and night, in summer and winter, a circulation of atmosphere commenced all round the sphere. The lighter gases going upwards, and the heavier subsiding, formed the elemental force—wind.

p The red, gaseous sheet encompassing the sun is continually being pierced, cleft, and fissured by innumerable specks, mounds, and ridges of a more brilliant matter, boiling up from below, and consisting of various metals, such as sodium, magnesium, carium, iron, chromium, nickel, &c., all in vapor form, and giving rise to the peculiar colors and phenomena of *faculæ* and the mottled appearance of the sun's surface. The most intense light will be between the volatilized metals of the chromosphore and the sun's centre.

p The lighter gases of the great mass were perpetually attracted to the centre warmth from the nebulous body, till they attained an unknown rarity—a rarity that lost its power of refraction, its sense of warmth, and its power of motion on the borders of the eternal, etherial space, where rotation ceased, and air, water, and matter rolled round in ceaseless energy within the cold embrace of that motionless, lifeless ether, perpetually drawn

From a globe of glowing gas it becomes a ball of liquid fire, enveloped in a smoky cloud. It gradually arranged itself into zones or layers in a molten state according to the specific gravity of the various bodies composing it, and even the atmosphere above was divided into layers. Close to the surface was a vapor of salt suspended in the air: there just above it was seen a layer of dark smoky carbonic acid gas, and yet another layer of oxygen and nitrogen with the vapor of water or steam existed.

As the Earth's surface cools, chemical bodies spring from each other, rushing to and fro, and combine with terrible explosions, and gas-hurricanes fling the elements into mingled disorder. The Atlantic and Pacific Oceans hang suspended in mid-air in the form of steam.[q] In cooling, the earth shrivelled up into folds forming mountain ranges.

"But since the uttermost limit of Being is ended and perfect,
Then it is like to the bulk of a sphere well-rounded on all sides,
Everywhere distant alike from the centre; for never there can be
Anything greater or anything less, on this side or that side."
—PARMENIDES.

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to and repelled from the light, doomed to those never-ending revolutions which give us our seasons, as the rotations give us day and night."—MALET.

oo Where is the promise and potency of man in all this? Little do these fiery tides look like the crimson currents that are to flow through his veins; or the ruddy banks that bound them like the flesh that shall enshrine him; or the scorching breath like the air that shall pass peacefully through his lips, and feed his lungs. Yet here, in this fiery hell, is the spirit that shall develop the world into an earthly paradise, and generate a being who is to wield the sceptre over all material creation.

p The sun from which the earth is supposed to have escaped is an intensely brilliant gaseous sphere, encompassed or covered by a less brilliant reddish-looking envelope of specifically heavier gases (metallic as well as non-metallic). This red, gaseous sheet is continually being pierced, cleft, and fissured by innumerable specks, mounds, and ridges or a more brilliant matter, boiling up from below, and consisting of various metals in a vapor form, and giving rise to the phenomena of *faculæ* and the mottled appearance of the sun's surface. There is a great commotion on its

surface, like that of an immense chaldron in full boiling, which causes heavier matter to move and keep itself afloat upon the surface. This matter, spreading over the sun's surface, forms the chromosphere. Its heat bears less than 1 is to 2, yet still hot enough to keep volatilized and in gas form all the various metallic substances, which it contains in great abundance.

Resting on this chromosphere are the strata of hydrogen, &c., together, of a depth from 5,000 to 7,000 miles.

And as the chromosphere is nothing more than the accumulated matter ejected by the faculæ, it follows that the chromosphere, the protuberances, and the faculæ contain similar if not the same metallic materials, which ultimately are carried down by way of the solar spots, to use again as faculæ and protuberances from the opposite side of the sun's surface.

The solar spots are all those places of the sun's surface where the heat-losing metallic matter of the chromosphere sinks down, and is engulphed.

In some cases solar spots of twice the circumference of the earth length have been observed. Frequently these spots last 40 or 50 days, and even have been extended to 183 days.

q [. . . " And, last of all, with inimitable power, and 'with whirlwind sound,' comes the potent agency of steam. In comparison with the past what centuries of improvement has this single agent comprised within the short compass of fifty years! Everywhere practicable, everywhere efficient, it has an arm a thousand times stronger than that of Hercules, and to which human ingenuity is capable of fitting a thousand times as many hands as belonged to Briareus. Steam is found in triumphant operation on the seas; and, under the influence of its strong propulsion, the gallant ship—

> 'Against the wind, against the tide,
> Still steadies with an upright keel.'

It is on the rivers, and the boatman may repose on his oars; it is on highways, and exerts itself along the courses of land-conveyances; it is at the bottom of mines, a thousand feet below the earth's surface; it is in the mill, and in the workshops of the trades. It rows, it pumps, it excavates, it carries, it draws, it lifts, it hammers, it spins, it weaves, it prints. It seems to say to men, at least to the class of artisans: 'Leave off your manual labour; give over your bodily toil; bestow but your skill and reason to the directing of my power, and I will bear the toil, with no muscle to grow weary, no nerve to relax, no breast to feel faintness!' What further improvement may still be made in the use of this astonishing power it is impossible to know, and it were vain to conjecture. What we do know is, that it has most essentially altered the face of affairs, and that no visible limit yet

The floor of the globe is now laid down, black, hard, bare, hot as an oven; it stretches away a craggy desert of desolation surrounding the globe, its monotony only broken by numerous volcanoes [r] in full operation.

Now the time comes to allow the formation of other bodies of seemingly random forms and shapes. The formation of water from the gaseous bodies commences. The combining action of oxygen and hydrogen gives out fearful flashes and sounds. There is no night with grateful shade and cooling dews; no winter, whose piercing winds may assuage this terrible heat, there is but one unvarying fiery day; one interminable burning year. Surrounded by an atmosphere whose bulk is vastly greater than that of the

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appears beyond which its progress is seen to be impossible."—DANIEL WEBSTER.]

At a recent meeting of the Photographic Society of France, M. Janssen handed round a magnificent proof of the late partial eclipse, and said a few words upon the long discussed question of lunar atmosphere. In speaking upon this subject he said: "Suppose for a moment that the moon is surrounded by an atmosphere, what would be the result if we took a photographic view of it during an eclipse? The lunar disk would be sharp enough, but there would be a gradual decline in density, as in a vignetted portrait. This is exactly the contrary which took place, as the proof will show. The lunar disk is very sharp, and the negative is rather intensified near the disk, probably from refracted light." M. Janssen appears to doubt the existence of a lunar atmosphere.

q "After the first day its crust retained heat enough to continue to hold the waters in a state of vapour . . . . dense masses of clouds, hundreds of miles thick, formed an envelope covering the globe . . . . The oceans had become filled, and the thick clouds had gone . . . One could see the heavens . . . . This must have been a period of inconceivable violence and uproar, when ten million Niagaras were pouring down on a yet almost glowing crust."—"THE MOSAIC CREATION," BY C. B. WARING.

"Liquid and solid hydrogen is blue."—RAOUL PICTET, GENEVA, JAN., 1878.

r A mass of lava, 1,600 feet thick, was ejected from Jorullo, in Mexico, and though above a hundred years have passed, it is not cool: the heat in the crevices is sufficient to char the end of a stick.—HUMBOLDT.

Earth itself, it looks more like a blazing[s] comet than a world destined to be the peaceful abode of human beings.

The water condensing as the Earth's[t] surface gradually cools, falls in drops, and is speedily dissipated in steam, rising in dense clouds to the heavy atmosphere. This cools the Earth's surface; water collects in deep ravines and enormous chasms—thus oceans were born amid thunderings, bellowings, and battles most dire—fire and water for ages in deadly conflict.

> "Fainter and fainter, like the dying roll
> Of thunder in the distance, Stygian pools,
> Whose agitated waves give back a sound
> Hollow and dismal, like the sullen roar
> In the volcano's depths."

The oceans being born, turbid, dark, heavy, and impure, amid heavings, roarings, flashings, and terrible storms and convulsions, yet the lashings of the huge unbounded, undefined, and uncircumscribed wave still pointed out to me the fearful struggle of some inward powerful commotion.

> "Earth felt the wound, and Nature from her seat,
> Sighing through all her works, gave sighs of woe."

There stretched a chasm miles away, "A whirling gulph of phantasy and flame," and, between the dark craggy walls that bound it, see the boiling lava, like a river of melted metals of various hues, rolling its waves along: now water flows into it; the ground moves under-

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s The secular inequalities in the moon's motion compared with eclipses 2000 years ago, have proved that the length of time which the earth needs in revolving once around its axis, has within the last twenty centuries not decreased even by 1-100th of a second. This proves that the velocity of the earth's rotation has not increased within the last 2000 years, which it certainly would have done had the mean temperature of the earth perceptibly decreased; for in that case its volume would have contracted accordingly. We are therefore justified in asserting that the mean temperature of the earth, at present, is not less, even by so small a quantity as 1-170 of 1° C, than it was 2000 years ago.

t "Wind and water existed before matter; and matter before any organisms."—Mallet.

Matter is now in the air, now in the plant, now in the animal, suffering a perpetual transmigration.—N. C.

foot,—what a fearful explosion! Rocks[u] in mountain masses are flung into air-like pebbles, and, falling back, break the yielding crust of the lava, and disappear in the boiling abyss beneath. The walls of the chasms are now uniting; their pressure forces up lava in fiery mountainous masses. Fire and water then struggle for ascendancy. Which conquers? Turn and view that muddy ocean: behind its turbid waves, dashing on the iron-bound shore, dense stormy clouds hover over it perpetually, whose darkness is only momentarily relieved by the numerous fires which cast a lurid glare on the vapory coating of the globe.

> "Forlorn and wild
> The seat of desolation, void of lights,
> Save what the glimmering of the lurid flames
> Cast pale and dreadful."

The Earth might then be said to assume a form, but not what it would have in coming *aions.*

> "It goes its glorious course to run,
> A fire-globe whirled from the burning Sun."

The water in the ocean at this time was more like sulphuric or muriatic acid, hence its dissolving powers were stronger than our ordinary combination of gaseous elements of Oxygen and Hydrogen (water). As the strong fluid descended, it wore down ridges of granitic crust, and thus formed a separate class of rocks at the bottom of the waters.

These sedimented matter, or deposit, int heo cean's depths formed layers, and heat, passing to them from the underlying fire, made rocks, they sometimes melted, and on cooling crystallised, and bore the appearance of crystalline or fire-made rocks. When the granite upheavings become worn down and laid in the ocean bed, layers of gneiss rock were formed. Quartz of granite-powder, separating from other ingredients of granite in undisturbed waters, by pressure became sandstone, and this,

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[u] "The stony rocks are not primeval, but the daughters of time."—LINNÆUS.

by alternate heat and cold, formed another metamorphic rock, called quartzite. Felspar, in like manner, was metamorphosed into shale.

When the granitic and metamorphic rocks were forming, no Sun[v] illumined the heavens, no life existed, no bird skimmed the suffocating and heavy air, no serpent crawled, no beast trod the heated ground, nor finny inhabitant swam in the steamy waters. Erebus was alone supreme.

> "Nor aught nor naught existed; yon bright sky
> Was not, nor heaven's broad roof outstretched above,
> What covered all? What sheltered? What concealed?
> Was it the water's fathomless abyss?
> There was not death—yet was there naught immortal;
> There was no confine betwixt day and night;
> Darkness there was, and all at first was veiled
> In gloom profound—an ocean without light,
> The germ, that still lay covered in the husk,
> Burst forth, one nature from the fervent heat,—
> Comes this spark from Earth,
> Piercing and all-pervading, or from heaven."
>
> —RIG-VEDA, B.X., Hymn 129.

When the black veil of the Earth is lifted, and glorious Apollo appears, mother Earth becomes pregnant. Thus Sol, the father, produces animal heat, and the Earth blushes at Sol's sunbeams.

*Animal life, being locked up in the Sun's rays, was set free, and swarmed in the aqueous fluids.

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v "From night, Sunshine and Day arose."—(HES.)

* Heat is not invariably essential to organic life any more than light; for from the experiments on board H.M.S. "Challenger," origin and destruction of life was going on thousands of fathoms below the ocean waves, where neither light nor heat existed.

Captain Nares, H.M.S. "Challenger," reports (18th January, 1873) that "at a depth of 2,025 fathoms on the east side of the rise, the sounding-rod was filled with decomposed rock, showing a rocky foundation: the dredge, however, brought up ooze." Here we have construction and destruction at very low depths; and we may rest assured that life had its negative state coeval with Creation. In fact, with ourselves our life is dependent

every moment on the destruction and renewal of our blood corpuscles.

w It is not only at the greatest depths of the sea, but also in every porous soil, that organic life and destruction is going on, which does not belong either to the animal or vegetable kingdom, viz., Mucous formations, which are called *Moneras* and Protistes.

w The whole animal kingdom consists of hundreds of thousands of different kinds of beings constructed on only four different plans, each one of which is expressed in thousands of different ways.

z In polarized lineïts, I think we have found the elementary essence or principle of both electricity and magnetism.

It seems very probable that two polarized lineïts tending with their versatile ends in opposite directions, by uniting the positive pole of each with the negative pole of the other, may be converted into a neutral electro-lineït or couplet acting like heat, which, however, is liable at any time to be disunited again.

Faraday published a valuable paper "On the Physical Character of the Lines of Magnetic Force," in which he urges the existence of *physical lines of force*, identical in their nature, qualities and amount, both within the magnetic and outside the same.

"I conceive that when a magnet is within free space, there is such a medium (magnetically speaking) around it."

"What that outer magnetic medium, *deprived of all material substance*, may be, I cannot tell;" but, "the curvature of the lines of magnetic force to me indicate their *physical* existence."

"As magnets may be looked upon as the habitations of bundles of lines of force, they probably shew us the tendencies of the physical lines of force as they also occur in the space around."

These lines in induced currents were such faithful companions, that he could not think without them, and in testing his views of the lines of physical force, both by experiment and by "close cross-examination in principle," he was never aware of any error involved in their use. In fact he admitted they led him safely through all the intricacies of all the most difficult questions he undertook to solve. Tyndall acknowledged that "the lines of magnetic force are continually before his eyes, and by their aid he collegates his facts."

Detached polarized lineïts pass along from the sun in company with the sun's heat, but in a much larger scale than from the earth's surface, and possibly the so-called *corona* observed on the occasion of total eclipses of the sun is a real magnetic aurora proceeding from that body. "The general radiated structure of

Continual changes occurring in the primeval atmosphere and sea would produce changes in the composition of animal life. [w] Animals being the result and expression under which they are born, I may naturally suppose, when the conditions change, the animal should change with them; if the conditions of life are abruptly changed

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the corona, and the great comparative outward extent of the luminous radiations in certain directions, have attracted the attention of the observers of all modern eclipses. Some streamers have been seen to extend more than one million miles from the sun, while others did not extend to one-quarter of this distance." Professor Norton says: "the corona's luminous radiations may be conceived either to be permanently connected with the sun, or to be composed of luminous matter *actually streaming away* from the sun into an indefinite distance in space." If for matter polarized lineïts were substituted, it would be more correctly stated. Possibly these streams of detached polarized lineïts may hereafter be proved to be electric and magnetic fluids; especially so, as the detached lineït must be supposed to have polarity, because its anterior end has been touched and operated upon by the monits radii, and received a certain amount of versatile activity, while its posterior end was operated upon only by the cosmolinea, so that the former, as the more active one, may be called the positive end or pole.

The heat which finds vent from volcanoes, craters, fissures and hot springs, &c., is probably accompanied by detached polarized lineïts, as electric phenomena seen on those occasions.

There are two kinds of extended emanations continually streaming towards the periphery of the universe. These are—1st, heat-lineïts; 2nd, struck-off or detached (polarized or magnetic) lineïts. Both kinds as soon as they arrive at the verge of the universe, are by the power of synduction of the cosmo-velo changed into parallel lineits, annexed to the gravitation cosmolineœ, and become parts thereof. We then have two universal emanations flowing constantly outward from all celestial bodies, viz.: magnetic-lineïts and heat-lineïts, but only one kind flowing inward towards those orbs' centre, namely, *gravitation*-lineïts.

[w] Cuvier remarks that the different tribes of animals may be said to be so many experiments ready prepared for us by nature, who adds to or takes from the aggregate of their organs, just as we might wish to do in our laboratories, showing us at the same time in their actions the results of such addition or subtraction. Now, if one of the additions be a nervous concentration, it is a result of organic perfectionment.

and transformed, the animals are of course destroyed. If, however, the changes are gradual, the animal is slowly modified into harmony with the environments.

Multiformity of circumstances produces multiformity of species. Development from the homogeneous to the heterogeneous, from simple to complex, from uniformity to multiformity, is caused by the terrene globe undergoing slowly and surely a development from a monotonous sameness with one aspect, constitution, and temperature, to an ever-varying scene of vicissitudes—so much so that scarcely one foot or atom of land resembles its partner contingent to it. This land of stupendous mountains, roaring cataracts,[z] silvery cascades, noble forests, and

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[z] Whenever we view the leaping, plunging, and rolling of cataracts, a presentiment tells us that some unforeseen yet powerful agencies are at work and unfettered in our midst, and yet we can scarcely appreciate how near we are to the wonderful workshops where mighty forces of motion (soon changing into heat) are being struck off by invisible hands (*monits*), and are able to furnish us all the electricity, magnetism, and dynamical powers, &c., which are over and above necessary to complete our perfection in science, and lead us up to the microcosmic soul of creation.

y "——— Loathed melancholy,
Of Cerberus, and blackest midnight born,
In Stygian caves forlorn,
'Mongst horrid shapes, and shrieks, and sights unholy."
" All monstrous, all prodigious things,
Abominable, unutterable, and worse
Than fables; yet have feigned or fear conceived,—
Gorgons, and hydras, and chimeras dire."

[3] Curious Electrical Phenomena on Pike's Peak.—Sergeant L. M. Dey, signal officer at the summit of Pike's Peak, writes:— " At 8.45 o'clock this evening, the 12th July, 1882, on opening the door, a most curious phenomenon met my astonished eyes. The line on the summit was distinctly outlined in brilliant light, which was thrown out from the wire in beautiful scintillations. On near approach to the wire these little jets of flame could be plainly observed. They presented the appearance of little electrified brushes or inverted cones of light—or more properly little funnels of light with their points to the line, from which they issued in little streams about the size of a pencil lead, and of the brightest violet color, while the cone of rays was of a brilliant rose-white color."

picturesque lakes was varied with the wildest magnificence and grandeur of Nature. Cloud-capped mountains crowned with towering masses of rugged crags, and immense glaciers with huge tempest-worn peaks, were seen in every direction, whilst the bottom of the valleys was covered by Moraine accumulations from the ice-streams of a million glaciers. Immense piles on piles of terraces were seen to be covered with everlasting snow and ice. [x] Stillness of death, with deep, gloomy woods, appeared to pervade the distant view. Deep solitary ravines walled in by precipitous cliffs destitute of vegetation, seemed to hover with grim satisfaction over the dark and troubled waters that lash and fret themselves at their feet.

Whilst peering wistfully in evanescent space, I dimly saw glouring, dark, undefined, and horrid [y] forms, the sight

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[3] "These little funnels of light pointed from the line in all directions, and were constantly jumping from point to point. There was no heat to the light, though it was impossible to touch one of these little flames, for as soon as they were approached by the finger they would instantly vanish or jump to another point on the line. Passing along the line with finger extended, these little jets of flame were successfully 'puffed out,' so to speak, to be instantly relighted in the rear. It was a curious and wonderful sight. No sensation was experienced on applying the tongue to the line. Not only was the wire outlined in this manner, but every exposed metallic point or surface was similarly tipped or covered. The cups of the anemometer, which were revolving rapidly, appeared as one solid ring of fire, from which issued a loud, rushing, and hissing noise. The wind vane represented a flaming arrow, and a small, round, wooden stake—stuck up in the snow to show the position of the gauge—was similarly tipped, as well as an angle of our stone chimney.

[3] "In placing my hands over the revolving cups of the anemometer—where the electrical excitement was abundant—not the slightest sensation of heat was discovered, but my hands instantly became aflame. On raising them and spreading my fingers, each of them became tipped with one or more beautiful cones of light, nearly three inches in length. The flames issued from my fingers with a rushing noise, similar to that produced by blowing briskly against the end of the finger when placed lightly against the lips, accompanied by a crackling sound. There was a feeling as of a current of vapor escaping, with a slight tingling sensation. The wristband of my woollen shirt, as soon as it became dampened, formed a fiery ring around my arm, while my moustache was

of which no mortal ken could know. No Sun cast its effulgent rays, for the frothy, boiling elements threw forth misty veils, which hid from my visual orbs even the dog-star Sirius, which had only then begun to shoot its rays into the etheric fluid matter. The sight was horrid: if mortal flesh had then existed, it would have dissolved through very fear.

"I fled and cried out Death,
And back resounded Death."

The foundations of the very depths appeared to be disembowelled, and Nature's death-throes, with her writhing, twisting, contorting agony, were hideous and dreadful to look upon. The din and hissing roar, the clashing of the etheric atoms, the destruction of molecular power reverberated as if all the artillery of heaven was directed against Nature's adamantine throne, and the gods were waging the dire and fierce event of annihilation. The vibrations of this dire discord swept me upwards like a fierce whirlwind forth issuing from the four combined heavens, by an irresistible yet invisible force of attraction and carried me forward into resistless space at a velocity exceeding my mind's thought. The misty epoch of centuries was countless, and antiquity hid its face at my approach. My sense of thought and motion returning, a thousand forms and powers of Nature's god appeared; electricity, magnetism, galvanism,—odyl, ozonic, and etheric force, with all the host of yet unknown illimitable

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lighted up so as to make a veritable lantern of my face. The phenomenon was preceded by lightning and thunder, and was accompanied by a dense driving snow, and disappeared suddenly at 8.55 o'clock, simultaneously with the cessation of the snow. I much regret that there was no one on the Peak to witness the phenomenon with me—it was a wondrously beautiful sight."—*Colorado Springs Republican.*

x Sound-waves are formed by the particles of air oscillating to and fro in the direction of propagation; in the waves of light, the particles of ether oscillate to and fro across the line of propagation.

If the medium for light propagation consisted of elastic widely separate particles, the vibration of light would take place exactly like those of sound in the air.

powers, of matter self-creating, and forms of misty shapes (even yet to human imagination and Gehenna hidden and concealed), had met, as if by chance, to try their mighty, ponderous, huge, and irresistible, sevenfold, adamantine forces against each other; and in that terrible and mighty conflict the very heavens and depths of hell shook to their foundation. In this vision I saw as if that—

> " Atoms and systems into ruin hurl'd,
> And now a bubble burst, and then a world."

I now felt a shock as if all the mighty volcanoes of the Earth had burst into action, and very Nature herself had exploded and dissolved in her labor-throes into her original elements. Flames of various undefined and hideous forms, colors, and brightnesses unknown to mortal ken, rolled and burst over each other and vanished into etherial space, giving place to other revolving, undiscovered and newer shapes. I was again drawn upwards by a vortex of etheric power with undiminished and increasing velocity, but in an opposite direction. My system became etherial, and was lost in space and *vacuo*; my memory being lost with my form, I remained like nascent oxygen ready to change my etherial element, to which a cataclysm had reduced me, and annihilated my former material visible essence. After a kalpa's rest, I felt as if aroused by some latent energy from a trance which outwears "the time of men, the gods' eternity." My recollection of past events rushed before me, and I might have exclaimed with Milton—

> " Who shall tempt with wandering feet,
> The dark, unfathomed, infinite abyss,
> And, through the palpable obscure, find out
> His uncouth way: or spread his airy flight
> Over the vast abrupt, ere he arrive
> The happy isle."

I again felt myself as if dragged by some overpowering and headlong force, at a regularly increasing velocity to the surface of the former fiery fluid elements, when my speed was arrested by great waters, which were tossing their huge billows to and fro. Though faintly visible, I distinguished mighty animals crawling, innumerable and

slimy as the River Styx, black and horrible, with immense trailing bodies; and other forces flying in the heavens, of undefined and of extraordinary form, and so dreadful to look upon, that I verily believed the hideous forms of black despair were in league with the Angel of Death.

"Nature appeared bewildered in diversity
Of marvels. Marvels most inscrutable,
Like Proteus, altered her shape and mould,
But Fate remaineth ever immovable
And changeless in persistency," outwears
"The crash of matter and the wreck of worlds."

I was again hurled heavenward by a shock as if caused by some convulsion of the axial line of the fluid elements. This shock was communicated in an opposite direction to which I was thrown. In my headlong flight I distinguished a glare, or simply the first rays of some bright body, peering through the reeking and hissing exhalations ascending from the bottomless abyss of fermenting fluid matter. No sooner had I perceived these rays than I was again dragged by some invisible force, through an impeding [1] etherial body, to the place of my former dissolving scenes; the scenes which passed and vanished before my eyes with increased and diminished light, and brought a day and night as nodules [5] of a graduated scale. Profound silence reigned in the animate world; the Azoic sea teemed not with animal life; the

1 The seeming action of a resisting medium on Encke's comet, also the evaporation of the tails of some large comets, seem to prove that space is not a void, but filled with some fluid of cosmical matter.

"Air of heaven or space-ether, the 'Ultima Thule,' was called by the Indian philosophers 'aka'sa': they thought it the medium of life."

Limited transparency of space, and retardation of planets show etherial matter to exist.

Non-luminous ether exists in the neighbourhood of planets, sun, &c., surrounding them on all sides. It is subject to gravitation, and must be denser nearer the sun. It is a resisting offering medium, and may to some slight extent enfeeble the transmission of light. Comets and the nebulous or cosmical vapor consist of non-luminous ether.

5 If nature gave fish immense time to develope their cold-blooded pygmy progeny, millions of years to crawling monsters, then to

wild cry of the sea-bird, and the dashing of monsters in the ocean's foam, did not enliven its desolation. The dash of the saltless billows, the howl of the storm, the volcano with its flames and earthquakes, were the only sounds which rolled through the atmosphere, and these[2] only spoke of turbulence and destruction. The landscape was only wild and stern. The waving forest, the beautiful green mead, formed no part of the scene: all was rugged, wild, and terrific. Continents slumbered beneath the ocean, and on their surface the thick strata was depositing itself. The Earth was a desert waste of broken rocks and volcanic fragments, and the awful, the sublime, and the terrific were mingled confusedly together. After a decade of thousands of years, I again returned to the spot of my

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advance beasts from small-pouched mammals, of the trias to mastodons and monkeys of the tertiary, will she not give time to humanity, her masterpiece, to arrive at perfect manhood. A perfect man the world has yet to see. I gave to the fish millions of years, who never desired; to the reptile, who cared not for them, to the beast, who heeded them not. How much more shall I give them to you. "Eternity is mine, and all that is needed is yours."

2 In beholding many of the important results in nature, especially those in the vegetable kingdom, you may ask, does the sun do it all? Strictly speaking, it is neither the sun nor the leaf with its intricate and wonderful power. The storing up of heat and the manufacturing of digestible substances are carried on by two sets of primitive powers: versatile activity on the one hand and *end-unition,* or the effort or power of lineïts to join each other's end to end, together with synduction or the power of lineïts, which are parallel, to form others parellel to their own direction and position, and draw any stray isolated lineït which may happen to come in immediate proximity to them.

Action and reaction between End-unition and Versatile activity, produces,✳ which we call a monit (atom). The radii standing thus form a globule. ●

3 Action and reaction between End-unition and Synduction produces cosmo-velo. ≡≡≡≡≡

Action and reaction between end-unition and end-unition, produces — — — — — — what we call cosmolinea.

Action and reaction between end-unition and synduction in spiral shapes, produces convolution.

Besides these four most simple compounds of extension, we have the fifth. Action and reaction between *Synduction* and Versatile activity beget the faculty of *Intellect.*

4

IN PHYSICS.

POWER.			FORCES.						
POWER-POINTS.									MATTER MONIT.
CONSTITUENT.	ACCESSORY.		CONSTITUENT.						
End-Unition.	Synduction.	Versatile Activity.	Constituent lineït of the monit.	Heat lineït	Gravitation lineït.	Velocity-lineït.		Detached	MONIT OR ATOM.
						Vis-viva.	nerve-lineït.	Polarized lineït	

IN MATHEMATICS.

MATHEMATICAL POINT.	MATHEMATICAL LINE.	MATHEMATICAL SOLID.

former vision, and beheld a large Silurian sea extending in every direction. The air, even in America, was tenantless, and the land without inhabitants.[6] Eozoon lay like thin extended layers of jelly at the bottom of the ocean, and protoplasms of Eozoon formed vast reefs of foraminiferous shells — ruins of hydroids, born of Medusæ parents, who were more ancient workmen than Polyps,—and broken stems of Crinoidines abounded in the rocks. The seas were only tenanted by *Cœlenterate* animals, animated jelly without parts, organs, or senses; by three-lobed articulate animals which have sent no representative down to us. Everything had a glory of its own! The salt in the seas sparkled like living gems; crystalline bodies emitted soft, brilliant, azure, and crimson emanations; sea-plants extended their broad arms, filled with hydrogenous life, and embraced the joy of existence.

> "Organic life beneath the shoreless waves
> Was born and nursed in ocean's pearly caves.
> First forms minute, unseen by spheric glass,
> Move on the mud, or pierce the watery mass;
> These, as successive generations bloom,
> New powers acquire, and larger limbs assume,
> Whence countless groups of vegetation spring,
> And breathing realms of fin, and feet, and wing."
>
> DARWIN [1791].

The convolution, the cosmo-velo, and the ordinate cosmolinæ, constitute the immaterial substance of the universal soul in its completeness—the *macrocosmic soul.*

6 In the amœbæ we behold the very birth of the digestive functions; and they do on a minute scale what we do on a large scale: and yet ours is intelligence—theirs instinct.

In several of the Protozoaries digestion is as completely lacking as in the vegetal kingdom,—e.g., in the Gregarine the alimentary substances are absorbed in the state of solution by all the points of the surface indifferently.

Amœbæ has assimilation, but not as yet discovered nerves. Its motions show more and more signs of purposiveness, and it is permeated by a network of incipient nerve-fibres in connection with rudimentary ganglia, near its free margin. (Schäfer, 1878; also, O. and R. Hertwig.)

Next to amœbæ are ciliated infusoria and rotifers, with organs of locomotion. The latter has a digesting apparatus. In the lower Silurian formation there exist polyps, radiata, also

The waters were somewhat thermal, still simmering from the proximity of the heated interior; the air was thick and moist, partly composed of carbonic-acid gas; the sky being filled with dense clouds and vapors, marked the transition from day to night by irregular periods of total darkness, and seasons of feeble illumination; the Sun not being permitted to aid vegetarian growth, terrestrial plants were hardly suitable for air-breathing animals. And the marine animals were principals of the calcareous secreting varieties and unicellular diatoms.

At this time, in the Canadian seas, was existing a very extraordinary object, *Eozoon Canadensis*, *Oldhamia radiata* of such doubtful composition that it has been ascribed of mineral organisation. Here were found Ooze and Eozoon intermingled at thousands of fathoms deep, with destruction and formation of life covering metamorphic rocks, gneissic and granitoid schists, composed of felspar, quartz, mica, talc, hornblende, and chlorite existed. Here were also found crystalline schists, quartzites, and serpentine limestones, and then, again, in close proximity, were forming semi-crystalline slates.

The gases, the minerals, water—in a word, all the constituents of Nature, having somewhat subsided, life now rapidly appeared on the scene. Here were the Medusæ feeding on silicious diatoms, and in future *aions* would whales feed on Medusæ.[8] No Polyps appeared on the scene; nor yet did any brain-headed animal exist.

In the earliest, or Primordial period, there existed of plants only water-organisms—tangled sea-weeds. Then

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numerous molluscs; trilobites (belonging to articulata), and even fishes and reptiles. *Vide* Sir W. Logan, "On Foolprints of Reptiles in Potsdam Sandstone of Lower Canada." (Quarterly Journal Geolog. Soc., Vol. VII., p. 247.)

[8] The Medusa has a nervous system—its underlying surface is permeated by a network of incipient nerve fibres in connection with rudimentary ganglia, near its free margin. (O. and R. Harburg and Schäfer; 1878.)

The genuineness of the Eozoön as to its animal origin has been satisfactorily proved by the Huronian fossils.

Eozoön has a silicated condition the same as Stromatopora, it being zoologically allied to it.

in the following, the Primary, came the more perfect cryptogams, such as ferns. Then followed, in the Secondary, pine-forests. In the Coal period the phanerogamia developed out of the more perfect cryptogamia. Not until the Chalk did the higher corollifloræ appear. In the beginning of the Tertiary the earth had sufficiently cooled at the poles, climate-zones were produced, and the land was covered with leaved forests. Flowerless plants had been succeeded by flowering ones, the latter first without a distinct corolla, and then by those with one; and of these, first the lower and then the higher.

Turning to the order of succession of animal life—of the Primordial, the forms are skull-less; then in the following, the Primary, came fishes, first those with the heterocercal tail; next, reptiles, birds, mammalia, and man.

Articulates, brachiopods, and rhizopods were in abundance, in company with Cystideans and graptolites; and [9] Crinoids (lilies) with short sharp spines instead of teeth; also a [7] fish two feet long, with soft body and no scales or teeth. Next large Trilobites, and small fish [10] of placoid and ganoid species, are just coming into view.

Then fish reptiles. with no hind-feet, crustacean fish, fossil-sponges, encrinites, obolella, water-bugs, and leech-like animals covered with hair, accompanied with their soft-bodied mates armed with horns appear.

Cephalopods next come on the scene with Polyeating crabs, and large trilobites with paddles, and perennibranchiate batrachia with permanent external gills.

There is also now an immense number of corallines and brachiopoda. Of these the best known are Terebratula and Lingulæ, a little lower than oysters, cockles and mussels. Molluscs exist in a wealth of species; and of these only two or three will come down unchanged into future times and seas.

I then view the Earth, and see it rich in algæ, lichen, liverworts, thalbus plants, club-moss, and frondose ferns, and a plant [11] with spreading leaves resembling the mullein,

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[7] Found in the Upper Silurian sandy, yellow, and Red Beds.

but without a stem. Sea-weeds were scattered in wild profusion along the sea-beach.

Of the three families Nummulinidæ, Globigerinidæ and Lagundœ, Eozoön belongs to the first and the highest in the rank. It is not therefore strictly true that it is the lowest of the animal kingdom, though very near to it. It belongs to an age where the predominant life is scarcely elevated above the working of crystalline forces.

Cuvier speaks of the inferior organisms as furnishing us with a series of experiments made by the hand of nature. In fact he assumes the organic series as a result of numberless organic blunders, abortive attempts, or freaks of nature.

Graptolites are common to America and Australia. They are found in the goldfield slates of Victoria; and are the nearest allies to the living (Hydrozoa) Sertularia and Plumularia.

Evidence of the existence of vegetation in Eozoic times is derived from the presence of iron-ores. The ores are first formed in the hydrated condition, and then lose their water by metamorphic agencies, becoming specular and magnetic, or the state in which the Laurentian irons are now known. Ores of iron are conceived to have been formed under similar conditions in all ages. At the present day they accumulate in swamps and low grounds in the condition of the hydrated peroxide, or bog-ore, oftentimes in company with manganese. Organic vegetable matter is requisite in order to extract the iron from the rock or soil and effect its deposition. The metal slightly present in the soil is the insoluble ferric oxide, or the familiar condition of iron-rust. Water charged with soluble vegetable infusions, like that in swamps too full of the disagreeable extract of leaves, etc., to be palatable, has the power of dissolving ferric oxide. The process consists in the removal of a part of the oxygen by the vegetable compound, or deoxidation, when the compound becomes changed into the readily-soluble ferruginous oxide. But this is an unstable compound in the presence of our atmosphere. The rejected oxygen is brought back again, and recombining with water, produces the hydrated ferric oxide, which is precipitated, and covers the ground on the bottom of the pool. Almost any swamp at the present day contains this reddish-brown coating of hydrated iron-rust. Where streams of water cause the swampy water to flow to lower regions, the iron compound is also conveyed in suspension, and in the course of a few years a thick deposit of ore is accumulated. In the New England States they used these beds for the manufacture of their pig-iron in localities where only the name now exists for the village, such as the Tamworth or Gilmanton Iron Works. All tradition of the manufacture there has disappeared. The Katah-

In a thousand years I again revisit the former spot of my contemplations, and find animals with brains enclosed in a cartilaginous cranium—a brain-pan made of gristle. The cuttle-fish had special ganglia (1) or masses of brain set apart for giving origin to nerves of sight.

Now a bastard or half-developed lobster (*Eurypterus*) with a large body, but slight feet and legs, mixed in the group, with the first appearance of our cannibal friend, jack shark, who dashes through the waves, and approaches in type (brain) the reptile class. He appears to be of the highest order, and is an associate of a rare individual named Megalosaur (carnivorous).

The Ceteosaur prefers safety by indulging in herbaceous novelties, while the Iguanadon, a kind of nondescript just entering the arena, is not recognised by the family compact of reptile, bird, or mammal.

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din Company, in Maine, however, and some others, still derive their ore supplies from this bog-compound.

This theory supposes that the principal iron ores in every age of the world had their origin in this way. There is no other agent save this organic extract which produces iron-ore on a large scale at the present day; hence it is rational to explain the origin of ancient ferruginous beds in the same way.

i The arthropods have a voluminous liver, especially the crustaceans and insects. Molluscs have a voluminous liver divided into lobes, fabricating at the same time sugar and bile, like that of the superior vertebrate. The pancreas exists in fish in a rudimentary state, but not clearly in invertebrate. Annuloida and Mollusca have colorless blood corpuscles.

j Plants are found growing nearly a half-inch long attached to the mucous membranes of the cavities in the stomach of living animals, and occasionally from the exterior covering of worms infecting the same cavities.

(9) It has frequently been considered that Australia has never been under water since the old palæozoic times of Brachiopods and Trilobites. (*Vide* J. E. Tenison Woods, F.G. and Lin. Soc. Report before Geolog. Soc.)

That, with a few exceptions, the organized bodies, Zoophyta, Crinoideæ, Blastoidæ, and amongst Mollusca, the Acephala, Brachiopoda, and Cirrhopoda must be considered as fixed to one spot during the whole of their perfect existence. — *Philos. of Zoology*, Vol 1. II., by Fleming. *Ancient World*, by Ansted, P.p. 38, 92, 95.—*Vestiges of Creation.* P.p. 178, 203.

In the vegetable world I now find the Club-moss in large size: the Scale tree has sprung into existence: frondose ferns exist in every zone from Greenland to the Line: then is first seen the Seal-tree and Conifers, and the *Cycas*, all prophetic of palms, with other vegetation.

Now the Nautilus, (2) with 114 kinsmen, comes sailing along in his beautiful canopied boat, then the Cephalaspis, with its true, hard, bony structure, differing somewhat from the protecting covering of crustacea. Here the oyster arms himself with a horny beak to push his friends out of the field when the struggle for existence comes.

At this time equal temperature and unity of type pervaded the whole globe : and a single fauna prevailed throughout, from the shores (3) of America to France. Beneath the sea the fucoids exhibited their variegated hues, and furnished exhaustless food for the strange forms of animal life. Molluscs seven or eight feet long, and other low forms of life, such as polypes, graptolites, and sponges were mixed in apparently strange confusion. The Crinoidines, Encrinites, Crustacea, (4) Nautilus, and Cephalopods, and all low forms of the Vertebrate Kingdom filled the ocean bed.

After *aions* of *aions* I beheld far-extended flats, washed by the tides, and strewn with sea-weeds; and gigantic

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(1) Light produces chemical change, and chemical change excites nerve-force. The co-relation is a sensation of light. Light, by exciting the activity and transmisson of nerve-force, excites that part of the brain which is the instrument of our visual consciousness. Globules one 30,000th of an inch in diameter are passed through the nervous filaments of animals.

(2) The Nautilus extends from the Palæozoic times to our seas; while Germs *Aturia* is only found in the Eocene and Miocene stratas of other parts of the world.

(3) From soundings made by the U.S. sloop Gettysburg, the Challenger, and the German frigate Gazelle, we may infer the probable existence of a submarine ridge or plateau connecting the island of Madeira with the coast of Portugal, and the possible subaërial connection, in pre-historic times, of that island with the southwestern extremity of Europe. A similar plateau connects the Canary Islands with the African Continent.

birds [k] were congregating there. The marine turtles, leaving their briny homes, crawl over the oozy or sandy shores, and the unique labyrinthodon slowly moved amongst the wondrous group. On the elevated grounds and hillocks, the zamia and palm (5) sheltered the Rhynchosaurus, the parent of the Oolitic marsupials, and in the thick forests, reptiles [l] fought their battles of extermination. We now sporting—

> "Of fish that, with their fins and shining scales,
> Glide under the green wave in sculls that oft
> Bank the mid-sea ; part single, or with mate,
> Graze the sea-weed, their pastures."

Here—

> "Life, in rare and beautiful form,
> Is sporting amid those bowers of stone,
> While the wrathful spirit of storms
> Has made the top of the waves his own."

I again return, after thousands of years; it is early morning, and the fog slowly rises from the land, unveiling a picture that dazzles us with its unrivalled beauty. In the Orient appears Sol, in all his effulgent rays and plenitude of glory; the pine-like trees upon the mountain

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[k] In forming bird's fore-feet, elevated hind-feet were employed for progress. Prone on the water, first it lay or crawled the ground, then slightly elevated, crept, fore-feet gradually useless; thence wings formed membranes, and its last feather is found in the sandstone.

[l] In consequence of the arterial blood of reptiles being always mixed with a proportion of venous blood, the temperature of their bodies is nearly that of the surrounding medium. Their organic functions are, therefore, much influenced by changes of temperature. Cold greatly diminishes the action of the heart and lungs, and slackens the play of all the vital organs. Diminution of the temperature to about 40° to 50° is almost always fatal to these animals. The skeleton of reptiles being found nearly entire in the liasic beds of the oolitic periods, and in other secondary rocks, leads us to suppose THAT as the glacial period.

(4) "The fish and the crustacean are wonderfully alike."—HUGH MILLER. They illustrate admirably how two distinct orders may meet.

(5) The Nipa Neameana palm has leaves 25 to 30 feet long; of which this plant carries six or seven leaves. Each leaf is divided into fifty or sixty pairs of pinnæ, two to four feet long.

tops are waving their lordly crests. Stretching away to a long bay or gulf is a slope overgrown with palm-like (6) and luxuriant tropical trees, from which dangle in the air, and stretch from bough to bough, vines clad with flowers of brilliant dye.[0]

On the shore of the bay is a flat beach on the land-side, and broad-leafed reeds with tufted tassels. This beach is wide, and composed of micaceous sand, and periodically covered by the high tide, and at times baked in the Sun's rays. Here the inhabitants come, crawling, hopping, stalking down to the shore, some as tall as giraffes, with bodies as large as oxen. Down they move in constant procession, across sands, to fish in the morning light. The water is alive with fish, frogs, and nondescript reptiles (7), swimming, crawling, diving, and flying, and filling the air with their din,—that din made horrible as the gigantic waders fill their crops with the crawling brood.

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[0] Eighty Roman feet was the breadth of a hollow tree in which Lucin Mutianus guested 21 persons.—(Pliny, xii, 3).

Adanson and Perottet assigned from 5 to 6,000 years to 32 feet, making it contemporary with the Pyramid of Menes.

Trees have been found measuring 102 feet in diameter at the mouth of the Senegal.—Ramusio, vol. i, p. 109.

A Eucalyptus on coast V.D. Land measured 70 feet round the trunk.—Backhouse in Emu Bay. Gould's "Birds of Australia," vol. i.

In Lithuania trees have been cut down 87 feet in circumference, with 815 annual rings.

Decandelle assigns to the Yew tree ("Taxus baccata") of Brabome, in the county of Kent, 3,000 years.

Adanson assigns for a tree of 32 feet diameter 5,150 years of age.—"Voyage au Senegal," 1,757, p. 16.

The dragon-tree of Oratava, the ancient Taora, was 79 feet round near the ground.

Bertholet, Nova Hector Acad. Leop. Carol., Nat. Cur. T., xiii, 1827, p. 781, says:—"Encomparant les jeunes Dragonniers, voisins de l'arbre gigantesque, les calculs qu'on fait sur l'age de ce derniere effraient l'imagination."

(6) The Diplograpsus Palm or double row cells belonged to the Lower Silurian or Cambrian age.

Identical plants were found in Lapland in 67° north latitude 3000 feet high, and on the summit of Mount Washington, north latitude 44°, 6000ft. high, while below this limit in woody valleys of the white mountains, U. S., there is not a single species

I now distinguish fresh water rivers, with abundance of shells, and fish[m] in shoals of every size and form in the briny element from the inferior (8) order of the vertebrate, viz., *myxene* and *petromyxon*, which have an affinity with *Amphioxus lanceolatus*, endowed like man with sanguineous globules, circular, and with double depressions, up to the highest ganoids and Placoids, who were now undergoing changes, as well as the two-winged *Pterichthys*, which were like ironclads amongst the denizens of the deep. It reminds us more of the turtle than fish. Here was seen the *Coccosteus decipiens*, a fish between a shark and ganoid, with a vertebrate tail; then the dog-fish, with a vertebrate spine; and the buckler, like that of a placo-ganoid.

The trilobite were diminishing in numbers, to be shortly supplanted by the Limulus[n]. Insect life is in abundance; flies and bugs varied the scene. The marshes abounded with Batrachians, or reptiles allied to the frog and newt, and some as large as crocodiles; and even in

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which occurs, also about North Cape. *Cerastium latifolium*, and *Ranunculus Glacialis* are found on the Alps between 10,000 and 11,000 feet high.

(7) In the Secondary epoch came reptiles, and out of them birds were developed. The decreasing amount of carbon and increasing of oxygen, permitted that change.

Of birds the earliest had long lizard-like tails composed of thin vertebræ, to every one of which were attached strong rudder-like feathers, in pairs. The same formation of the tail part of the vertebral column still occurs transiently in the embryos of later birds.

The transition from the reptile to the bird is manifested by some of the latter, having teeth set in one order, in grooves, in another, in distinct sockets.

m The "pleuronectes" limanda in the Loire have both eyes on one side of the body.

Plagiostomes are well-developed fish. Fish hear well, and will come when called by name; their sense of smell is well refined.

n Butterflies have been found on Mount Blanc.—Saussure.

Dipteras, an insect like a flea, has been found 2,600 feet higher than Mount Blanc.

Some of the Rodentia, Cheiroptera, and Insectivora occupy the lowest grade.

the Scottish seas were seen reptiles six inches long. Here in Creation everything is rising in scale of organization, and approaching nearer to the types of modern living forms.

The Limuli race is now approaching. Amongst the thousand kinds of fish[o] now swimming, all will differ in

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In the class of insects, especially the Hymenoptera (to which the sphex belongs) we find the most remarkable examples of contrivance, and of skilful adaptation of means to ends; each insect knows how to recognise what agrees best with it; they eat jalap, and other drugs, taking nutritive parts and leaving purging properties. The adaptation of means to ends results not from an exercise of intelligence on the part of the animals themselves, but from their blindly following out a path laid down for them by the Almighty designer. If this be so with the sphex, it may well be asked,—what, then, is an intelligent act?

The "peramelidæ," or bandicoot tribe, are evidently analogous to insectivora; it takes the place in Australia of shrews, tenrecs, &c., of the Old World.

The proteus lives in deep caves in Illyria, in air or water, on rocks, or in mud.

(8) In the most inferior vertebrate, the one, which in a certain measure connects the vertebrates with the mollusks, the amphioxus, the liver is represented by a cæcum of a greenish tint, reminding us of the simplest cul-de-sac, short, not ramified, which seems to play the part of the liver in the invertebrates. It is also under an analogous form, under the form of a pointed cone, that the liver originates in reptiles, birds and mammifera.

An example of the production and perpetuation of life is furnished by the proteus of Illyria. It may be asked whether the proteus is not the larvæ of some large animal inhabiting the limestone cavities: its feet are not in harmony with the rest of its organization, and were they removed, it would have all the characters of a fish. Sir H. Davy thought the proteus was not a larva, but much larger when matured in its native place, but not in caves. He founded his views on what he THOUGHT A FACT, that there is no example in Nature of a transition from a more perfect to a less perfect animal.

The Dytiscus (beetle) spends the day in water and the night on the wing.

[o] The carp, by a rotatory motion of the gullet, brings vegetable food within the action of the strong pharyngeal grinding teeth.—OWEN.

(9) No fragment of a quadruped, bird or reptile has been obtained from any of the carboniferous strata in any part of the world.

identity from species which shall appear at a more modern epoch. The placoid and ganoids now come into view, and approach, in many important points of their anatomy, our cold-blooded enemies the reptile class.

In fish we have now the grand pattern of all vertebrates, animate, living, or extinct. In this pattern there is the "promise and potency" of all forms of vertebrate life, as we have in the earth-worm potentinally all the forms of articulate life.

Another Epoch appears before me called the carboniferous[9], where insect life is most prolific ; centipedes, scorpions, spiders, cock-roaches, and may-flies abound. Now is seen the frost-lizard, the Archegosaurus, a species of amphibia, the advance guard of reptiles is seen in active life, a form between frogs and ganoids, and, as Professor Owen says, the most exemplary instance of transition form on a derivative hypothesis of air-breather

(9) The fossil remains of the true coal measures are the same to westward of the Alleghany as in New Holland, India, South Africa, the neighbourhood of Newcastle and vicinity of Edinburgh. Are the zoological and geological epochs established as true in science if those competent to judge in the affirmative, then must every interpretation of that brief portion of sacred page inconsistent therewith be rejected as spurious, and the advocates of error consigned to occupy a page in the History of Prejudice, along with the persecutors of Galileo.——*Hist. of British Annuals*, p.p. 16–18. By J. Fleming, D.D.

Syringograde animals suck up water to cause motion.

Medusæ use a rythmical contraction and dilatation of their disks to propel themselves.

The rotifera uses a vibratile action.

Grasshoppers, although not formed to swim, propel themselves in water with much facility by a backward or kicking motion of the hind legs.

The eel goes into meadows to catch worms.

The Zeus insidiator forms its mouth into a tube and squirts water at flies which rest on leaves.

The gold-fish makes a nest with leaves, and the parents watch it in turns. The stickleback also makes a nest. Fish have been known to come to the shore to receive their food when a whistle was sounded. "Do you think fishes have less sensibility than man," says Sir W. Scott. "It is a delicate question, and one which fishes alone would be able to solve."

from a water-breather.[p] Here are found small animals—land-snails, Pentremite (between *crinoids* and *ecchinoderms*), moths, crabs or house-building crustacea, mussels, and walking-fish, a species of the *ceradotus Forsteri* (Burnett Salmon), a link between fish and lizards, with gills and one lung, which would produce its ancestor in the carboniferous and cretaceous form. Air and water would be indifferent to it. Broad-headed reptiles with webbed feet, also broad-headed snakes 20 feet long now abound. The Labyrinthodont and kangaroo-reptiles are now denizen of terra firma.

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[p] Man from his origin undergoes seven distinct correlated forms: for nine months his type of life is aquatic; afterwards he becomes a lung breather.

Trigonia, a shellfish, suddenly disappears as well as pleurotomaria, at close of Cretaceous period, and only two have been found in Tertiary.

Three tribes have been found in the Pliocenic and Miocenic Tertiaries, near Melbourne, in Victoria.

In the older Pliocene formation of the Australian gold-fields was found Rhytidotheca Lynchii, belonging to the Meliaceous Orders, showing the clime was formerly warmer and more humid and equable than the spot where the vestiges of extinct forests abound.

The Thyoclaleo carnifex (lion of Victoria) the Thyl. Oweni of N. S. W., lived in the Pliocene Tertiary.

The Trigonia existed in Tertiary, while Cyprœa was found in Oligocene Tertiary.

Carcharodon sharks were abundant in Miocenic Tertiary.

Carnivora whales, Phocodon or Squalodon, are found in the Miocene Tertiary of Malta and Bordeau, and in Victorian Tertiary sands.

Mammaliferous crag of English Pliocene Tertiary period corresponds with the gold drifts of Australia and Russia.

The Fern genus Fœniopteris Pecopteris Australis abounding in the Mesozoic rocks are obtained from the coal formation of Victoria.

In the Mesozoic times all Australia was under the sea.

Impari-pinnate ferns Gangamopteris are found in Mesozoic age. Cycadeous plants are not found in Palæozoic coal-fields, but are characteristic of rich Oolitic or Mesozoic coal-fields of India, China, Richmond in Virginia, as well as in the great Oolite of Yorkshire.

The Australian coal deposits are in the Mesozoic age.

In vegetation we find the horse-tail ferns, tree-ferns—then come cycads (10), firs, coal-trees, the rough-barked club-mosses flourish, with sigillaria and sugar-bearing trees; thence appear pond-weeds, and the palm and lily tribe, and finally we see pitcher and air plants, melons, parasitic plants and fungus, with large birch, walnut, and sycamore trees, and also all plants having seeds with two lobes.

Another Epoch presented itself to me. There I saw insectivorous mammals connected with marsupials, and of a type nearly allied to birds: here the Dinosaur

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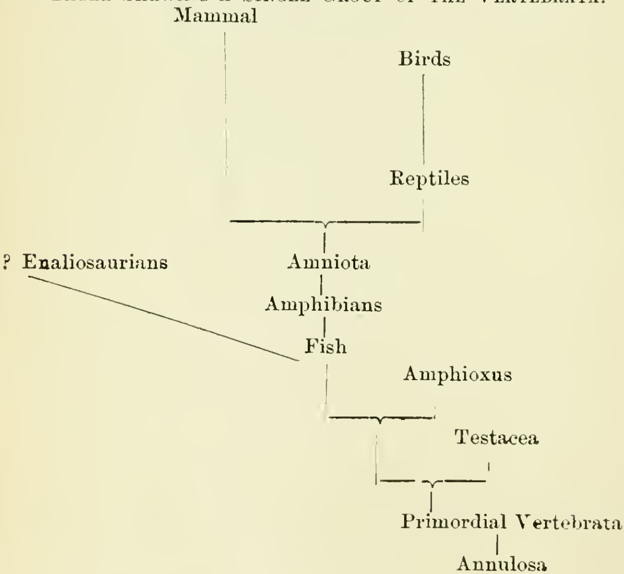
The Voluta Anti-Cingulata (Class Gasteropoda) are found in the Lower Miocene and Tertiary Clays.

Zamia plants of Mesozoic forms and Lepidodendrons are found in Palæozoic coal-measures.

Gangamopteris ferns are found in the Mesozoic coal-beds of N.S.W.

Table Shewing a Single Group of the Vertebrata.



(10) Found in fine sandy silurian beds of Victoria.

(fierce lizard), which was neither bird, reptile, nor mammal, but a compromise of the three, roamed at liberty and probably left its footprint in the Triassic bed, it being a bipedal with type of a bird's foot.

I now saw the Enaliosaur (swimming lizard), with neck twenty feet, and body fifty feet long, covered with bony plates and mounted on whale-like paddles; while Pterosaurs (winged lizards) skimmed the surface of the Earth and Sea. Birds, mammals, and fish filled up this era. The fish had part tail vertebrated and part invertebrated. Here we could easily, as Agassiz says, write the progress of the age as marked in the tails of fishes.[q]

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[q] Agassiz was deceived as regards the earliest undoubted remains of reptiles: he could not distinguish whether they belonged to fishes or salamandrial reptiles, or reptiles resembling the salamander's skeleton, they being somewhat cartillaginous or gristly; while they belonged to the batrachia, the lowest order of reptiles.

Numerous reptiles, as well as certain fish, amphibians, and even birds have lymphatic hearts. The hearts are partial dilitations of the vessels, and are animated by regular pulsations, e.g., 60 beats a minute in frogs and 44 beats a minute in toads.

Reptiles have first typical foot with five digits, horse one digit, cattle two digits, rhinoceros three digits, hippopotomus four digits, cat and dog four on front and five on hind feet.

The cat crawls on its belly, and when in motion and seen from above, a continuous wave of movement is observed traveling along its spine from before backwards. The movement closely resembles the crawling of the serpent and the swimming of the eel.

The Jerboa leaps nine feet at a time.

The bull-frog of America, when pressed, can clear from six to eight feet at a bound, and even jump a fence five feet high.

A species of chætodon ("chalmon rostratus") can shoot flies at six feet distance; it occasionally misses, but generally succeeds; for, as the poet says—

> " Honest instinct comes a volunteer,
> Sure never to overshoot, but just to hit,
> While still too wide, or short, is human wit."
>
> —POPE'S ESSAY ON MAN.

The serpent has no limbs, yet it can outclimb the monkey, outswim the fish, outleap the Jerboa, and spring into the air and seize birds upon the wing; it has neither hands nor talons, yet it can outwrestle the athlete, and crush the tiger in the embrace of its ponderous overlapping folds.

The Ichthysaurus rapidly approaches, then the Dolichodeirus, a long-necked animal twenty-eight feet in length, followed by the Pterodactylus [r] crassirostris (thick beaked) of Saurian characteristics. It could fly, had wings like a bat, and tail of mammals.[s]

Vegetation was principally ferns, cycads, and conifers.

Soon appears the maleosaur fish, a Saurian and bird which had an affinity to fish and Saurians. Now half appeared, in the pelvic arch of a Dinosaur, the mammal; and now, in the neck and head of a kindred Dinosaur there half appeared a bird, its hinder parts already free—a bird in all parts except in teeth, fore limbs, and tail.

Another Epoch (11) passes. I return, and, ascending through the carboniferous rocks, I find marine objects becoming gradually fewer in number. There I lose corals and encrinites, also trilobites, and as they disappear their place is taken by living crustacea, which may be regarded

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Between the skulls of serpents and those of amphibians there are few points of special community, while there are many features which remind us of the osseous fish and the bird.

r The pterodactyle was a toothless pteranodon, while the hesperonis had teeth, a heir-loom from the reptile class.

s In birds approaching animals, the OS INNOMINATA are always anchylosed together, but are never united below except in the ostrich.

The sparrow-hawk can admit air into its bones, but not many other birds.

The temperature of birds is 107° F.

The Vampire Bat of the Island of Bonin can swim. Dr. Buckland also thought the pterodactyle could do the same.

Insects, bats, and birds are as heavy, bulk for bulk, as other living creatures; and flight can be performed perfectly by animals which have neither air-sacs nor hollow bones, air-sacs being found in animals never designed to fly, such as the great air-sac occupying the cervical and axillary regions of the orang-outang, the float or swimming bladder in fishes, and the pouch communicating with the trachea of the Emu.

In the First or Transition Epoch, (11) which includes coal measures, there was a predominance of vascular cryptogamia, a comparative rarity of gymnospermous phanerogames.

In the Second Epoch, there was an approximation to equality of vascular cryptogamia, and of diocotyledons, composed entirely of gymnosperous phanerogames.

as the nearest relatives of these trilobites—I mean the Limuli, or King-crabs. The King-crab may probably be evolved from the Trilobite. I find here the last descendant of the expiring trilobite preserved in [t]carboniferous rocks.

Now approaches the Oolitic and Cretaceous champions, the Plesiosaurus and Iguanadon (vegetable feeder).

> " See ! Late awaked, emerging from the woods,
> He stretches forth his stature to the clouds,
> Writhes in the sun aloft his scaly height,
> And strikes the distant hills with transient light.
> Far round are fatal damps of terror spread,—
> The mighty fear, nor blush to own their dread ;
> Large is his front, and when his burnish'd eyes
> Lift their broad lids the morning seems to rise."
>
> " The fiend,
> O'er bog or steep, through straight, rough, dense, or rare,
> With head, hands, wings, or feet, pursues his way.
> And swims, or sinks, or wades, or creeps, or flies."

A troop of a similar regiment now comes marching along, the Saurians and Teleosaurians ; the latter will be well depicted by the gavial or Indian Crocodile, in company with a beautiful feathered reptile, the Archeopteryx.

The Ichthyornis, with a bi-concave vertebræ, an heirloom inherited from the fish, the bird, and the reptile, acts

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In the Tertiary Epoch, there was a predominance of diocotyledons, and a paucity of vascular cryptogamic plants ; and, that, during each of these three periods, remains of monocotyledonous plants occur, although sparingly.

Robins have been known to flutter and make a noise to attract the gardener, and when he followed the bird, he found a reptile was robbing its nest.

The corn crake simulates death, the same as a man when attacked by a beast ; even the oppossum acts the same.

Ravens, when domesticated, will often fight for wine, when they have been accustomed to it.

The Jerboa and other small animals will store up food in granaries, which action even human beings often despise.

A chick will follow the call of the mother from a box, although it never had heard the sound of her.

[t] Fossil trees in the coal formation have been found erect with a circumference of fifteen feet.

as provost guard. We only find fish [u] like the salmon or cod when we reach the Oolitic period. Here is a gap which connects sharks with lower forms of life. If we take a salmon or a cod we see the vertical tail divides into two nearly equal lobes, and if we trace its long vertebral column or back bone, we see it terminates midway between the upper and lower lobes of the tail; but no such fish is to be found in any of these ancient rocks.

Living [v] birds have bony members of the tail short and compact; all their tail feathers are attached to the very last joint of the tail, which is rather broad; but in fossil birds there is a long tail, and each of its bones has one pair of feathers attached to it, and no more; there are twenty pairs of feathers. If birds produced the Triassic footsteps in Connecticut, they came late into the world, if only two-legged reptiles produced them, then the Archæopterix is the oldest bird.

Species of shrimp, lobsters, ecchini, next appear with the Cestracion (Port Jackson Shark), and ganoids with the posterior extremity of the vertebral column, terminating on the centre of the tail. Insects, reptiles, and reptile-birds, brought up the rear.

I now reach the magnesian Limestone, where reptiles of a high order flourish. These are partly allied to lizards, and partly crocodiles. Here is seen the connecting-link and gradation. Lastly, before this period vanishes from my eyes, I behold the true mammalian quadrupeds, the Microlestes, a kind of Marsupial allied to Opossums of America and Australia. It appears to belong to the upper town of the Trias.

In the Cretaceous age we find Encrinites undergoing change; all the old types are disappearing, and the Mar-

[u] When the Carib fish of the Llanos River sees blood, its sanguinary appetite is at once aroused, and it immediately develops its cannibal propensities.

The Payara fish cuts like a razor; neither copper, steel, twine, or wool can withstand it: they are alike dangerous to man and beast.

[v] Ostrich, penguin, and cassawary have imperfect wings, whilst the New Zealand (Kiwi) apteryx lacks both wings and tail.

supite are becoming prominent. In crossing from the Cretaceous to the Tertiary bed, molluscous form of life undergoes a sudden change.

I again view this secondary strata, and find the cretaceous layers filled in with flint and green sand: here we find the remains of our Pterosaur friend in the cretaceous bays and seas, followed by all our Saurian relations—the Ichthyosaurus, Plesiosaurus, together with our Pterodactyle cousin. But our most powerful neighbour, *Mosasorus Hoffmanni* was rather reluctant in attending their funeral obsequies, he preferring another higher and drier burial ground.

Immediately another host of visitants appear, the *Lyodon dispelor*, the *Pythonomorphus*, one hundred feet long, in company with the huge turtle (the *protestega*). Here was the battle ground for supremacy—here Protheous met Elasmosaur, or Pythonomorphus, a spectacle which was not a picture of that pre-adamite innocence and repose which moralists and theologians, ignorant of science, have so gloriously delighted to paint in glowing colors. The only kindred of our Saurian friends was a bird in every way excepting his teeth, which lingered behind as a vestige of its mate the reptile.

In the Eocene (12) city there is a creature between the pig and the tapir—then is seen the Hyænodon, one of the oldest carnivora, not found above the Miocene. Its teeth are occasionally found in Tertiary sands.

In the Eocenic suburbs we have *Zeuglodons Cetoides*, species of whales [w] armed with teeth: these supplanted aquatic reptiles—its head was seal-like—its spinal-column, limbs, and body 100 feet long—predominantly whale form.

In visiting the Eocenic inhabitants I find monkeys lower, and more generalised than Lemurs. Here also was

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[w] Medusæ feed on salacious diatoms, while whales feed on medusæ.

(12) The bifurcation of European placental mammals began in Eocene; and it is to this that we must look for the earliest appearance of the Primates. Lemurs then existed in Europe and

America of a transitil type, showing resemblance to hoofed animals of the same age, the ancestors of our own horses and tapirs. No doubt plasticity was then great, and ancestors of higher apes began to differentiate themselves from the ancestors of the modern Lemurs.

In Mid-Miocene strata at Thenay, Abbe Bourgeois found split flints, some of them bearing traces of fire, and believed to be of artificial origin. M. de Mortillet, Dr. Haury, M. M. de Quatrefages, Worsaae and Capellini confirm it.

M. Ribeiro, of the Portuguese Geological Survey party found wrought flints in Miocene deposits of the Tagus, and which were exhibited in Paris, 1878; on these and other facts M. de Mortillet pronounces for a Tertiary man; but as he carefully distinguishes from Quarternary man, "l'homme de St. Acheul," the "river drift man" of Professor Dawkins, he may mean belonging to a genus as ourselves, yet so far unlike us, so little differentiated, as to be man only in the generic, not in the specific sense.

In the Miocene, the specialization of Primates must have been first, for in early Mid-Miocene strata in Continental Europe we find a large anthropoid ape, identified as a close relation of modern gibbons.

If bifurcation of Primates had proceeded so far, that even existing genera of higher apes had been fairly well demarcated, must not then the ancestors of man have already begun to be generically distinct from the ancestors of the other anthropoids?

It is not consonant with analogy to suppose that the monkey group should have separated from the Lemur group in the Eocene; that anthropoid apes should have separated from the monkeys in the lower Miocene, and that the human genus (as distinct from the fully developed human species) should have separated from the anthropoid apes in the Mid-Miocene. There seems to be good reason for this conclusion.

The Orohippus is derived from the Palæotheridæ, from which Rhinoceroses and Tapirs arose; they, however, being a separate line.

The Palæotheridæ gave rise to a distinct branch, the Macrauchenidæ.

TERTIARY.

AGE OF MAMMALS.

Pliocene.	Miocene.	Eocene.
Horse.	Miohippus (Anchitherium)	Orohippus.
Pliohippus.	Mesohippus.	Eohippus.
Protohippus.	Brontotherium.	Coryphodon.
		Tillotherium.
		Dinoceras.

first met with the origin of our horse, *Orohippus*, the size of a fox. It had three toes, with a vestige of a fifth one. Here I see in the Sunda and South Sea Islands the [x] Flying Lemur, which is a station on the way from Lemurs to Bats. The short-footed species point the way up from semi-apes to true apes.

The monkey was limited at this time, and more resembled hylobates, or long-armed apes of India.

Now appears the Pæbrotherium, a creature resembling mammals, but with a predistinctive neck-feature of the Camel; this was an inhabitant of the Rocky Mountains of America (*procamelus*).

The deer appearing at this time have no antlers; in the middle of this epoch they appear with simple antlers and two branches, while in the upper part of this age they are furnished with three antlers.

Our horse appears again rather changed in the foot—he is called *anchitherium;* he has three toes, with middle one much enlarged.

Now comes on the stage the Deinotherium (" *terrible beast*"); this links sea-mammalia and land mastodons. It has tusks 12 or 14 feet long, and each weighed about 60 to 100lbs. At the Academy in Aurora, State of Illinois, U.S., I have seen tusks weighing 40lbs, 8 feet long, and double teeth which would fill a barrow,—it was herbivorous.

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x Unitahtherium, king of the later Eocene, and nearly as large as its predecessor, had brain only the size or a little larger than that of the kangaroo.

" Eobasaleus" the " King of the Eocene," though the size of the elephant, had only the eighth part of its brain.

The flying lizard, flying lemur, and bats, connect terrestrial progression with aërial progress, so the auk, penguin, and flying fish connect progress in water with progress in the air. The travelling surfaces of these anomalous creatures run the movements peculiar to the three.

In the higher stage of this era, I see [y] Mammalia, Quadrumana—apes, lemurs, cheiroptera (hand-winged), Insectivora—shrews, moles, hedge-hogs, Carnivora—cats, dogs, weasels, bears, flesh-eating mammals with shark's

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y In mammalia, where hair is absent, bony-plates, or scales take its place; they are destitute of gills, but have circulation of hot red-corpuscles, except the camel, which is without any nucleus. They possess milk-glands, and generally are covered with hair.

All animals possessing two condyles on the occipital bone, and having non-nucleated red blood-corpuscles, suckle their young.

Viviparous generation, with process of suckling their young, is confined to mammalia, and afterwards succeeded by the simple oviparous form.

Urinary organs end with mammalia, many of which have no gall-bladder, or omentum, e.g., birds, some fishes, some reptiles, &c.

Cuvier says that several mammalia have a distinct membraneous fold at the entrance of the vagina, and others a decided contraction in the same situation. He states, on the authority of Stella, that the Northern manati has a strong semilunar fold at the orifice of the vagina, contracting the entrance of that canal; that the mare and ass have a similar structure, and that in the OUISTITI ("simia jacchus") it is the same.

In the brown bear there is a thick lip-like fold of the internal membrane, reducing the entrance of the vagina to a simple transverse slit; and the hyæna exhibited an analogous structure. A young hyrax had a very distinct circular hymen—(CUV. LEC. D'ANAT. COMP. T.V., p. 131, 132).

The clitoris and nymphæ, as well as the hymen, have been supposed peculiar to the human female; the latter are generally absent in mammalia; but Blumenback informs us that he had a lemur which had them closely resembling the human ones. Blumenback saw it of the size of a fist in a batina stranded on the coast of Holland—De.g.h. var. NAT. LECT. I-8—(Ibid) (Leb cit. p. 21).

The absorbent system ends in the vertebrate animal department, of which only mammalia and aves possess lymphatic glands.

The diaphragm ends with mammalia, so that the thorax and abdomen are not distinct in any other animals.

Many mammalia, particularly among quadrumana, have cilia in both eyelids, as with the elephant.

Several animals secrete tears. Steller informs us that the phoca, ursina, pallao, and the camel do so; and Humboldt thinks a small American monkey does.

teeth [z], Cetacæa—whales, grampus, and porpoises, &c.,

Hitchcock thinks the Anomœpus major combined characters now distributed amongst birds, lizards, batrachians, and perhaps mammalia.

In terrestrial animals the herbivorous digestive tube is more differentiated, more complex, furnished with gastric pouches, with cæcum, vaster and more numerous than the carnivorous digestive possesses.

The porcupine has fourteen stomachic cavities, but aquatic animals have a simplified digestive stem. In the herbivorous cyprinus there is not even any stomachal distention, and the same is the case with tadpoles. The cetaceous herbivoral (the lamentine, dugong, &c.) have only one stomach, with simple or double dilatation; while the cataceous carnivora (dolphin, whale, &c.) have three, four, or five stomachs, and the "squalus peregrinus" many stomachal cavities.

The protozoa has neither digestion nor circulation. After the protozoa come animals having a digestive cavity, but none other, such as coral polpyi or anthozoids, the hydramedusæ, the ctenophore: next an organic progress is accomplished in the næmattelminta.

The teeth and stomach of the kangaroo remind of us Ruminantia.

The Sivatherium, the size of an elephant, links the elephant and Ruminants.

The bateen whale and the great ant-eater do not possess teeth.

Whales and seals have no external ear; the whale has no cæcum, and with many there is an absence of a gall-bladder.

Many animals, such as quadrumana, have the organ of touch, and an uvula the same as man.

The "panniculus carnosus," a sub-cutaneous stratum of muscular fibre covering the ventral and lateral parts of the trunk, immediately under the skin, does not exist in man, nor even in the chimpanzee. It is found, however, with the monkey.—Tyson.

Brains of animals are perfect at birth.

[z] The sea-bear ("Otaria jubata") walks with tolerable facility, and appears to fly through the water: in fact, I may say, birds swim in the air, and fish fly in the water. The sea-bear can partially rotate and twist its arms, and present one time its palms to the water, and next instant its edges or narrow parts. With birds the reverse occurs, the anterior or thick margin of the wings being invariably directed upwards.

The guillemots in diving do not use their feet—they literally fly; the loon employ their feet, rarely their wings.

(z) Fossil sharks, Cacharodon Megalodon, have been found in the Miocene Tertiary of Victoria.

Rodentia,—Rats,[1] hares, and beavers, Edentata,—toothless sloths, ant-eaters, and armadillos,[2] Aves,—Archæopterix with lizard tail, and each bone had one pair of feathers attached to it.

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[1] In New South Wales and parts of Victoria there is found a curious rat, endowed with remarkable instinct. It builds a stockade to protect itself against all enemies by entwining sticks amongst the polygonum shrub. Another species displays even greater ingenuity; it first selects two immovable points, and then entwines sticks between them, so that not even the native dog can remove them. These remarkably strong structures consist of several storeys—chambers above chambers, united by galleries and passages built up from the surface of the ground to the height of two or even three feet. These stockade rats are the only members of the race, so far as I am aware, which build strong dwelling-houses for themselves. These rats are unique in their class, and approach near to the beaver in building for themselves protective works. With these vermin we see instinct and reason is given so far as to enable them to live and elude pursuit and capture from their foes.

Beavers live in societies, build villages; each family has a hut—choice of place—preparation of material—disposition of the causeway—building huts—which are all witnesses to intelligence. Some say the beaver is not an inventor of all these things; it is only following the blind instincts of its nature; that it has always lived thus, and cannot live otherwise. This opinion is absurd, as beavers of one district have adopted totally different modes of life in another. On the upper Rhine, where the beavers have been hunted down, they have taken to burrow amongst the piles by the sea and river banks, where it would be dangerous to remove them, on account of causing damage to the dams and protective works. In comparison with man, we may say that the mason becomes a miner, but man first hid in caves and afterwards constructed huts. F. Cuvier had a beaver which was never in the water, yet it ate bark and piled up the sticks for future use. M. Flouren, when reviewing Buffon's opinion on beavers, says that he (Buffon) takes results of instincts for results of intelligence. A beaver in the Museum of National History at Paris piled up branches and food and intertwined them to keep out the cold, and especially at the front of his cell where the snow accumulated. This shows instinct and intelligence. What other name can we give to a series of facts, having for its object the application of instinct to circumstances the animal had not foreseen.

(2) The bustard is possessed of a greater gular sac or pouch, instead of air-sacs.

Renal capsules, similar to mammalia, are found in birds

Now soon appears the Dinotherium Sivatherium, of stag-like appearance—a ruminant;—has two pair of horns, and is associated with Tortoises 18ft. long.

I now beheld a beautiful country of vast extent, diversified by hill and dale, with its rivulets and streams of mighty rivers flowing through fertile plains. Groves of palms and ferns, and forests of coniferous trees clothed its surface; insects of the beetle tribe were sporting their tiny wings throughout the forest,—and I saw monsters of the reptile tribe, so huge that nothing among the existing orders can compare with them, basking on the banks of the rivers, and roaming through its forests; [3] while in its fens and marshes were sporting thousands of crocodiles and turtles.

Winged reptiles of strange forms shared with birds the dominion of the air, and the water teemed with fishes, shells, and crustacea; and on the coral banks, where the sea-weed waved, and the purple polypi spread out its arms in search of food, crustacea descendants of the trilobite, the lobster, the crab, the shrimp, and limulus sported on the sparkling sands, and there, too, the mollusca and other aquatic forms congregated. The hardiest and most vigorous of these, the Terebratula, the Lingulæ, and

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Birds have a third eyelid.

The birds called Autophagi run about and provide for themselves as soon as they leave the shell.

The woodpeckers climb by the aid of the stiff feathers of their tails; sparrows and thrushes advance by a series of vigorous leaps; the ostrich takes readily to water and crosses from island to island; jackdaws will use materials and matter, in occasionally building a nest, a custom which is quite foreign to birds; the red-breasted horn-bill fastens up its mate till the young ones are able to take flight.

The swallow, martin, snipe, and many birds of passage, also the wood-wren, willow-wren, black-headed bunting, and canary (five of which are birds of passage), have no air in their bones. Out of 92 birds, says Crispo, many had air; five had air in humerus; not in inferior extremities, 39; no air in extremities, and probably none in the bones, 48. The apteryx and bat have no air-cells. The swan and goose have air-sacs.

(3) The crocodile has a bird called the "Charadius Egyptus," described by Hasselquist, which enters the crocodile's mouth and picks off the Bdella or insects. Herodotus calls it the Conops: it is called "Zodie" in San Domingo.

the Obolella, found as congenial a home as amongst the wave-washed rocks of the Silurian wastes. And I beheld the terrible encounters between the gigantic and ferocious denizens of the forest, and the equally ferocious monsters of the briny ocean. The blooming roar rolled through the forests skirting the Ganges and the Mississippi, which terrified the more timid animals on their shores, and was choed by a thousand voices rolling in thundering sounds over the sea, and reverberated through the forest.

There, too, were cries of the combatants, "fierce as ten furies, terrible as Hell," in the agonies of death as those huge reptiles grappled in deadly strife, breaking down forest-trees in the encounters, and rivulets of blood flowed from their lacerated veins.

After the lapse of many ages I again visited the Earth; and the country, with its innumerable dragon-forms, and its tropical forest, had dissappeared, and an ocean had usurped its place. And its waters teemed with nautili, ammonites, and other cephalopoda of races now extinct, and innumerable fishes, and marine reptiles, and *Pteranodon*, a new order of *Pterodactyle*, were in abundance.

Another sight now opens before me, deer with luxuriant horns appear—also Edentate connecting with the Megatherium and the Glyptodon, which latter terminates gradually in cuirass-coated gentlemen, such as the turtle.

> "Now half appeared
> The tawny lion pawning to get free
> His hinder parts."

The Hipparion, the Protogen of our friend the horse, of Oregon, with a foot more changed, a large central toe, and smaller one outside, appears to enjoy the grassy prairies.

Then I view the ox, camel, sheep, and *deer, with

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* The reindeer has, like several baboon tribe, large laryngeal sacs on front of the neck, communicating with the larynx.

The deer, when in its fastest gait, gallops like a horse, but ordinarily it bounds in the air.

Deer, antelopes, oxen, tragulidæ were derived from Anoplotheridæ as well as hippotamuses and swine, the latter forming a separate link from the former.

enormous numbers of Australian kangaroos[6] and opos-

(6) "The kangaroo when hard pressed in the chase will generally, without slackening her speed, stretch her fore legs downwards to the pouch, and with a sudden jerk, eject the occupant. The young one so cast out generally goes off to the right or the left at full speed. Perhaps it will be as much in vain to inquire into the motives of a kangaroo as of a human being. We can only take notice of the action and conjecture what may be the motive, and whether it is prompted by instinct or something like instinct. So long as the mother is under no apprehension of being overtaken, maternal love prevails, and she carries her offspring with her, but when she perceives that the dogs are gaining upon her, fear overcomes love, and self-preservation is the one object kept in view. Or is the action prompted entirely by maternal love, and is thus merely a cunning expedient in the last extremities for saving both mother and offspring, or at least one of them, from self-destruction? In whatever light we may regard it, the action seems very much like the result of a decision of the judgment after a process of reasoning. There is apparently a weighing of probabilities and a decision arrived at.

There is another curious fact observed by those who have hunted this ancient animal. If water is within reach, when hard pressed the kangaroo will always make for it. He does not go beyond his depth, and standing with his fore-quarters out of the water, he waits patiently the arrival of the first dog which ventures to swim within his reach, when he coolly takes hold of him by the neck, pushes his head under the water, and keeps it there till life is extinct. Many a fine courageous dog has perished in this way. Whether this cunning process, this easy way of smothering an enemy, was known to the ancient fathers of the kangaroo family we can have no means of proving or disproving. It may not even be a true instinct, such as is usually understood by that term; neither may it be ascribed to 'inherited experience,' but merely to a process which each at the moment of conflict discovers for himself. It requires no great stretch of the imagination to suppose that a kangaroo standing up like a man in water too deep for a dog at once understands that he has complete command of him, and we may even suppose that he quickly discovers that under the water a dog is much quieter, or soon becomes so. But here we are met by the enquiry—why does the kangaroo take to the water if not for the purpose of gaining an advantage over his enemies through his ability to stand up in it when other animals cannot? Water such as he will often rush into affords no protection to him, except for the express purpose of drowning his enemies."

The kangaroo possesses a clavicle and corresponding motions partially the same as man, and hence can employ its paws

sums. Mammals with one excretory duct like a bird, and the Ornithorhynchus, with several New Holland birds are seen in great numbers.

At a shorter period I again see Paleotheres, [7] Elephants, Mastodons, Giraffes, Rhinoceroses, Tigers, Camels, Antelopes, Monkeys; Ostrich class—moas, emus; also crocodiles and tortoises. Here was seen a species of Elephantine stag, with four horns and proboscis.

At this time South America received from North America a half-made camel, which she never improved upon. The Llama remains, and is the highest South

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as a means of defence. The head, trunk, and forepaw appear to be a portion of a small animal unnaturally joined to the legs of another of greater dimensions and strength, and when full-grown exceeds a man in common height when standing erect. It is more than a match for an unarmed man, and standing erect will box with one of its hind legs; its tail and other hind leg acting as a support when fighting. Sydney Smith gives a humorous account of a kangaroo, which, if literally correct, would make it the most wonderful animal in creation. He says of it:—"A monstrous animal as tall as a grenadier, with the head of a rabbit, tail as big as a bed-post, hopping along at the rate of five hops to a mile, with three or four young kangaroos looking out of the pouch to see what is passing."

A Mr. Anderson, living at Cape Schank, near Melbourne was seized by a kangaroo and carried to a swamp above a quarter of a mile distant, and was only saved from being drowned by the attack of his dog on the kangaroo.

The opossum feigns to be dead, and then runs away as soon as the hunter leaves it.

(7) The camel, elephant, rhinoceros, and horse have no gall-bladder.

The mammary glands are only two with the elephant, goat, and horse (sometimes more); cow, stag, and lion have four, cat eight, pig and rabbit ten, rat ten or twelve, the agouti twelve or fourteen; amongst monkeys or bats they are placed upon the throat, as in man (in the lower part of throat). With a great number of carnivora they are on the belly or abdomen as well as the thorax; and in the horse, cow, and sheep they are placed further back, near the hip joint.

American ruminant. She made nothing better of the pachyderm given to her than a peccary, but she developed the humble edentata into the bigness of an elephant.[8]

The Miocene period produces Mammoths, Mastodons, Hippopolan, Rhinocer, Bear, Monkey, Hyæna, Giraffe, and Deer.

The higher apes now diverge from the lower apes, such as, for example, the Dryopithecus.

Here there is a connection between the Semnopithecus and Macaus.

We have now the Uintahtherium of Leidy, Loxolophodon of Cope, and *Dinoceras mirabilis* of Marsh. It appeared to be composed of Elephant, Rhinoceras, Ruminant, and Marsupial. The beast of the Uintah Mountains had its companions—tapir-like, camel-like, hog-like, bear-like, tiger-like, and horse-like. Its country

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(8) The mastodon's brain was small when compared with that of the elephant.

Mr. Frank Calvert has recently discovered, near the Dardanelles, what he regards as conclusive evidence of the existence of man during the Miocene period. Mr. Calvert had previously sent some drawings of bones and shells from the strata in question, which Mr. Busk and Mr. Gwyn Jeffreys were good enough to examine. He has now met with a fragment of a bone probably belonging either to the dinotherium or a mastodon, on the convex side of which is engraved the representation of a horned quadruped, "with arched neck and lozenge-shaped chest, long body, straight fore legs, and broad feet." "There are also," he says, "traces of seven or eight other figures, which, however, are nearly obliterated. He informs me that in the same stratum he has also found a flint flake, and several bones broken as if for the extraction of marrow."

M. Oelert, Director of the Museum at Laval, has discovered a considerable number of fossil remains in the department of the Mayenne, especially in a grotto existing in Louverne, in the carboniferous limestone of that region. It is upwards of 24 metres long by 8 metres high, and comprises three chambers communicating with each other by very narrow passages. The relics found in it consist of four human molars of persons of different ages, upper part of a humerus of a tall man (which was found lying in the midst of a mass of ashes), a flint implement, the

was the fruitful womb of the tapir,[9] the rhinoceros, the tiger, the pig, the horse, and the camel, which passed, one form into South America to appear as the Llama, and another form into Asia, there to bide man's coming, and, by serving him, to civilize him. — (*Amer. Dist. of Alabama.*)

I look around me and see in the Miocene Tertiary[10] Seas of Australia luxuriant marine fauna, and especially *Catenicellidæ*, but they flourished much more South of the Tropics than in the North Tropical or Temperate Zone.

Thousands of centuries rolled by and I returned,

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antler of a reindeer bearing an incision evidently made by the hand of man, bits of coal, and the bones of various animals. M. Oelert has found stones symmetrically placed so as to form an artificial floor, so that the existence of man in this place is abundantly proved; he is, moreover, found to have been a contemporary of the hyæna and rhinoceros.

(9) The ancient Anoplotherium, allied to the Tapir tribe, had equal length of teeth as man. This is a special exception amongst animals.

(10) "A marked and almost complete separation subsists between the fossil faunas of the Old World, America, and Australia. . . . . Australia is especially characterised by the exclusive prevalence of the marsupial type, which is altogether absent in other parts of the Old World, and represented only by a single genus in the New; AND IN ITS FOSSIL FAUNA WE FIND AN EQUALLY STRIKING PREVALENCE OF THE SAME SINGULARITY. According to Professor Owen . . . . . on the formation of the most recent tertiary periods in the limestone caverns of Australia abundance of mammalian fossils have been found, but except a single tooth of a mastodon, ALL of MARSUPIALS. Among them are fossil kangaroos, potoroos, wombats, dasyuri, etc., equalling the lion and leopard in size. . . . . On the other hand EUROPE, ASIA, AND AFRICA HAVE NOT OFFERED A SINGLE MARSUPIAL FOSSIL in the pleiocene and pleistocene deposits [upper divisions of the geological strata]; AND THOSE IN AMERICA ARE LIMITED TO THE GENUS DIDELYHUS (OPOSSUM), SPECIES OF WHICH AT PRESENT EXIST THERE;" and "the distinction between the fossil faunas of America and the old continent is not less marked." See also Professor Owen's "British Mammalia," p. 45.

and lo! the ocean was gone and dry land had again appeared, but it was covered with groves and forests; but these wholly different in character from those of the vanished country of the guanadon. And I beheld quietly browsing herds of deer of enormous size, and groups of elephants, Mastodons, Megalonyx, and other herbivorous animals of colossal magnitude. And I saw in its rivers and marshes the Hippopotamus, the Tapir, the Rhinoceros, the Dinotherium, the Veranidæ, the Mosasaurus, and the Varaus. And I heard the cry of the fox, and the howl of the wolf and the monkey, and the roar of the lion and the tiger, and the yell of the hyæna, and the growl of the bear.

Another epoch passed away, and I came again to the scene of my former contemplations, and all the mighty forms and species had then a more extended geographical distribution than those forms which would follow in future ages. I now soon saw them disappear: the face of the country no longer presented the same aspect—it was broken into islands, and the bottom of the sea had become dry land, and what before was dry land had sunk beneath the waves.

Herds of deer were still to be seen on the plains, with swine, and horses, and oxen, and bears, and wolves in the woods and forests.

Another authority, Professor Huxley (Lectures to Working Men, p. 143), says:—

"THE ANIMALS, FOR INSTANCE, OF THE NEWEST TERTIARY ROCKS IN ANY PART OF THE WORLD ARE ALWAYS, AND WITHOUT EXCEPTION, FOUND TO BE CLOSELY ALLIED WITH THOSE WHICH NOW LIVE IN THAT PART OF THE WORLD. For example, in Europe, Asia and Africa, the large mammals are at present Rhinoceroses, Hippopotamuses, Elephants, Lions, Tigers, Oxen, Horses, &c., and if you examine the newest tertiary deposits, which contain the animals and plants which immediately preceded those which now exist in the same country, you do not find gigantic specimens of Ant-eaters and Kangaroos, but you find RHINOCEROSES, ELEPHANTS, LIONS, TIGERS, of different species to those now living, but still their close allies."

(10) The desert sandstone of Victoria is a Tertiary deposit.

Then we have—

"Away, away! from the dwellings of men,
By the wild deer's haunt, by the buffalo's glen
By valleys remote, where the oribi plays,
Where the gnu, the gazelle, and the hartebeest graze,
And the Kùdù and eland unhunted recline
By the skirts of grey forests o'erhung with wild vine;
Where the elephant browses at peace in his wood,
And the river-horse gambols unscared in the flood,
And the mighty rhinoceros wallows at will
In the fen, where the wild ass is drinking his fill.
Or the brown Karoo, where the bleating cry
Of the springbok's fawn comes plaintively,
And the timorous guagga's shrill whistling neigh
Is heard by the fountain at twilight grey;
Where the zebra wantonly tosses his mane,
With wild hoof scouring the desolate plain;
And the fleet-footed ostrich over the waste
Speeds like a horseman who travels in haste,
Hieing away to the home of her rest,
Where she and her mate have scooped out their nest,
Far hid from their pitiless plunderer's view,
In the pathless depths of the parched Karoo."

I now view the resources of the ocean, and find the ammonite is vanishing from my sight, for it has arrived at last—

—"At a sea long past,
And as they reached its shore,
On the storm-winds breath came
The blast of death,
And the ammonite lived no more.
And the nautilus, now in its shelly prow,
As o'er the deep it strays,
Still seems to seek in bay and creek,
Its companion of other days."

Another era passes, and I revisit the Earth, and still find the Dinotherium, Mastodon,[11] Elephant, Megath-

(11) Discovery of a Mastodon.—American papers announce the discovery of almost a complete skeleton of a large mastodon in the townland of New Windsor, near Newburg, in the State of New York. It was found in a "swale" or marshy bottom, which runs away for several miles and drains into the Hudson. At the spot where the discovery was made, there was, some fifty years

erium with the Zeuglodon conquerors of the land and the sea. Moas and other birds occupied the isles of New Zealand, and monkeys pilfered in France and Greece.

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ago, a large pond, which has been in great part dried up. The excavations now made show that the soil all around is rich black alluvial mud of unknown depth, indicating that years ago there was here a wide-spreading marsh, or lake. Probably, as in the case of other skeletons which have been found, the monster waded in beyond its depth, got fast in the mud, and so perished. The present discovery was purely accidental. Some boys were engaged in making a drain, and about two feet below the surface came upon a huge bone 2ft. 10in. in length. They were amazed, and consulted their father, an Irish peasant, named Kelly. He was so puzzled that he ordered work to be suspended, and summoned his neighbors to council. This was on Saturday, July 5, 1880. Next morning several men assembled, dug a great trench over 30 feet long, and unearthed the greater portion of the skeleton of a mastodon. The *New York Herald* gives the following particulars :—"When the upper jaw of the skeleton was found there was great difficulty in getting it to the surface whole. It took five men to lift it out of the trench. It was 4ft. 6in. below the surface. The lower jaw was 4½ft. below the top of the ground, and some 3ft. distant from the upper jaw. It required two men to bring it out of the trench. The measurements of the chief parts of the bones already found are as follow :—Skull, 2ft. 5¼in. high ; length of the upper jaw, 3ft. 9in.; width of upper jaw, 2ft. 4in.; between the eyes, 2ft.; depth of forehead, 11in.; eye-holes, 7in. in diameter ; ear-holes, 18in. in diameter. On each side and above the mouth are holes measuring 6½in. in diameter and 2ft. deep. There are eight teeth in the skull—two on each side of the upper and lower jaws—and all in the best of condition. The back teeth of the lower jaw measure 7in. in length on the surface and 4in. in width. The front teeth, up and down, are 4½in. long on the surface and 3½in. wide. All the teeth protrude from the jawbones 1½in. There are eight forks on each of the hind teeth and six on each of the front teeth. The space between the rows of teeth on the roof of the upper jaw is 7½in. and on the lower jaw 6¼in. In the centre of the forehead is a cavity measuring 11in. long by 4in. wide. The lower jaw was placed in position and found to measure correspondingly large with the upper jaw, and making a perfect skull. Although not weighed at this writing it is estimated that the skull complete will tip the beam at not less than 600 pounds. One of the fore-legs, including the thigh-bone, measures 7ft. in length and weighs, it is judged, 150 pounds. The first joint of the hind-leg measures 2ft. 5in. in length, and the second joint of the same leg 3ft. 4in.

Vegetation was at its height, and man[12] chasing the wild animals of the forest. The Oresdon, between a pig and a deer, the Irish Deer, and Siberian Mammoth were enjoying themselves in Europe.

And I beheld colossal human* beings having small holes on their necks, marking the vestige of branchial

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The only part of the other fore-leg yet found, and which was the first piece discovered underground by Willie Kelly, measures 2ft. 10in. in length and weighs about 50lbs. At this hour 26 ribs have been discovered, and the largest measured 3ft. 10in. and is 2in. wide in the centre. A dozen or more sections of the spine have been unearthed, and the largest measures 10in. wide by 16in. long. A score or two other bones and pieces of bone are among the lot, prominent among them a toe-bone, measuring 6½in. by 4½in. It is thought to be fully as large as the mastodon now in Boston and found on the Brewster farm, three miles north." In the year 1845 a mastodon was found in this same marsh, about three miles from the site of the present discovery. This skeleton was purchased for 10,000 dollars, and is now in the museum at Boston. Another skeleton was found a few years ago at Otisville, also in the same district.

(11) Remains of an enormous dinosaur have been discovered in Colorado and received at Yale College, which, according to Professor Marsh, would indicate the length of the entire animal to have been about fifty or sixty feet! Portions of the sacrum and of the posterior limbs have been preserved; the last two vertebræ are nearly complete. From all the indications, Professor Marsh concludes that it was an herbivorous reptile, and perfectly distinct from any species known. He names it *Titanosaurus montanus*.

(12) Juvenius, the cotemporary of Julius Cæsar, says that at the Creation, beings of colossal stature and huge monsters existed.

"The gods themselves came later into being; who knows from whence this Creation sprang?"

"The Talmudists say Adam had a wife called Lilis before he married Eve, and of whom he begat nothing but devils," which explains the Scripture—"There were giants in the Earth in those days."—Pererius in Genesin, lib. iv., in cap. 3, v. 23.

*An Account of Giants.

The os frontis in the anatomical school at Leyden, though it be so vastly large, cannot in the least be suspected to have appertained to any other animal but a man, being complete every way, and answering in all particulars to the common forehead-bone of other men, excepting its magnitude. And arguing from the proportion that the same bone in other men bears to their

arches or gills covered with hair, the dark Ishites, and the fair Hadamhah or Adamites, progeny of Kyomurz, or Gil Shah, or clayman. A filthy, wily herd, cunning as the serpent, of speechless and fearful hideous forms to look upon, crawling upon all fours, and fighting with their claws and fists for acorns and roots. A thousand years had passed away, and I beheld the descendants of these fierce and hideous beings had begun to arm themselves with clubs and spears; and they had formed themselves habitations, covered themselves with skins, built huts covered with the bark of trees for their shelter and pro-

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height, it must follow that the man to whom this os frontis belonged was more than twice the height that men usually are, according to the common course of nature. And setting down, as the most moderate computation, but 5½ feet for the height of a man, he to whom this bone belonged must have been more than 11 or 12 feet high.

There is a manifest alliance and congruity observable in nature, between the stature of a man's body and his age during the time of his growth; and as 5½ feet may well be esteemed the most settled and ordinary degree of height in a man, so about 70 years may justly be allowed the most common period of his age: we have daily instances of exceptions; Thomas Parr and Henry Jenkins, both of England, and the old Countess of Desmond and Mrs. Eckleston, both of Ireland, who fully completed double the usual term of life; so we have no reason to question the accounts given us of others, that have been found in stature double the common standard of man. Nay, both longevity and high stature naturally so result from their proper causes, that they are often observed to become hereditary, and run in whole families; whence the Greeks had their Macrobii, and the Romans their Celsi; and in Palestine, of old, they had their Anakims, or sons of the giants. So that human gigantic bodies are nowise inconsistent with the course of nature. And, indeed, we have testimonies from authors of unquestionable credit, that there have been men in the world, and it is likely there still are, of such stature, as properly to deserve the name of giants.

The first I shall mention is one measured at Dublin, in the year 1682, his name Edmond Malone, who measured seven feet seven inches. Walter Parsons, porter to King James the First, born in Staffordshire, was nearly of the same stature; and I find several other men born in England who have arrived to this height.

Isbrand Diemerbroeck, in his Anatomy, tells us that he saw at Utrecht, in 1655, a man 8½ feet high, all his limbs well

tection, enclosed pastures for cattle, and were endeavouring to cultivate the soil. Their shape was, however, of slighter and diminished build from that of the original fearful tribes and progenitors.

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shaped, and his strength proportionate to his height; he was born at Schoonhoven, in Holland, of parents of an ordinary stature. Mr. Ray, in his travels, mentions having seen this man at Bruges, in Flanders. Johannes Goropius Becanus, who lived in Flanders, has recorded several instances still more remarkable. He says he saw a youth almost 9 feet high, a man near 10 feet, and a woman quite 10 feet in height. Pliny the naturalist particularises several men in his own age much of the same height as those mentioned by Becanus.

To these histories we may add the many concurring testimonies given us by various travellers of gigantic men seen in their voyages in the more remote parts of the world. Andreas Thevet, in his Description of America, tells us, that he was shown by a Spanish merchant the skull and bones of an American giant, who was 11 feet 5 inches in height, and died in the year 1559; he showed them to M. Thevet, who took the measures of the principal of them; the bones of the legs measured three feet four inches in length, and the skull was three feet one inch about. Which circumference is exactly proportionable to the length of the legs; and if we make an allowance for the hair and skin that covered the skull when he was alive, it falls very little short of the dimensions we have before set down, in computing the size of our giant's head when it was entire.

From these warrantable histories, and this particular bone before us, we may clearly deduce that there have been human bodies 11 or 12 feet high; equal to the stature of the tallest giants mentioned in Holy Writ. For the height of Goliath of Gath is expressly said to be about six cubits and a span; and taking a cubit in the most usual acceptance for a foot and half, his stature will not amount to above nine feet nine inches. Indeed, we may reasonably conclude that Og, the King of Bashan, must have considerably exceeded Goliath in height, if we make an estimate of his stature by the dimensions of his bedstead, which is said to have been kept as a memorial of him at Rabbath of the children of Ammon, and to have been nine cubits in length; but then we cannot imagine but that his bed must of necessity have been much longer than his body; and the least allowance we can make for the overplus is the space of nine inches above his head, and as much below his feet; and if we make this deduction, it will follow he was not above 12 feet high; much of the same standard with this giant, whose forehead-bone is still kept in the medical school at Leyden.

	Stature.		Length of Os Humeri.	Length of Ulna.
	Feet.	*Inches.*	*Inches.*	*Inches.*
An Englishman	6	4½	16	12¼
Ditto	6	1	15½	11⅝
Ditto	6	0	15	11⅝
Ditto	5	9½	14	11
Ditto	5	7	12¾	10
Ditto	5	4½	12⅝	10 1-10
Ditto	5	0	12¼	9⅜
Englishwoman	5	4	13	9¾
Ditto	5	0	12¼	8¾
European male skeleton ...	5	8	13	9⅞
Ditto	5	5	12¼	10
A Negro at the Lunatic Hospital, Liverpool	5	10½	15	12¾
Another from Virginia ...	5	5½	13½	11¾
Another from the Gold Coast	5	8	13	12¼
Another	5	0	12	10½
Negro skeleton	4	11	11	9⅞
Another	5	7½	12¾	11½
A Lascar	5	4	12¾	10½
Venus de Medici	5	0	13½	9¾
TYSON'S chimpansé (Simia troglodytes)	2	2	5½	5½
Mr. ABEL'S orang-outang ...	2	7	9	10
CAMPER'S ditto	less than 30		8½	9
Mr. WHITE'S monkey ...	2	2	4½	5

FOOTPRINTS IN THE SANDS OF TIME.—The latest Geological "find" is a series of human footprints on the sandstone of a tertiary quarry near the State prison of Nevada, and a peculiarly interesting feature of it is that these pre-historic men evidently wore sandals on their feet. Stone implements of pliocene have before been found in many places along with the bones of extinct animals; but this is the first time that their actual footprints have been discovered in the sands of time. As described by Dr. H. W. Harkness, who has been sent to the spot by the Californian Academy of Sciences to report upon the phenomenon, there are six separate sets of sandal tracks, forming the trail as it were of a hunting party. They were impressed in the flaky mud and sand of an ancient lake-bed, among the prints of numerous birds, deer, wolves, and mammoths. In nearly all, the toe portion of the sandal is clearly shown, and the grooves are as smooth as the work of a mason for a distance of two or three

inches. Back from the toe the outline of the sandal continues and follows that of the human foot, the curve of the instep being graceful and the toe well shaped. In the tracks, the toes are turned outward, like the print of a white man's foot, as distinguished from that of a North American Indian, which, as is well known to frontiersmen, turns inward at the toe. The strangest thing about the footprints is their unusual size, the length of the sandal-mark being nineteen inches, and its breadth at the ball of the foot eight inches, and six inches at the heel. So extraordinary are these dimensions, that Professor Le Conte, of the California University, doubts their human origin at all. However this may be, the discovery is extremely interesting, and it is to be hoped that a specimen of these natural casts will be obtained for the British Museum.—*Globe*

In the *Kansas City Review of Science* there is an account of the opening of a mound in Ohio in U.S. The mound was opened by the Historical Society of the township, under the immediate supervision of Dr. J. F. Everbart, of Zanesville. It measured sixty-four by thirty-five feet at the summit, gradually sloping in every direction, and was eight feet in height. There was found in it a sort of clay coffin including the skeleton of a woman eight feet in length. Within this coffin was found also the skeleton of a child about three and a half feet in length, and an image which crumbled when exposed to the atmosphere. In another grave was found the skeleton of a man and woman, the former measuring nine and the latter eight feet in length. In a third grave occurred two other skeletons, male and female, measuring respectively nine feet four inches and eight feet. Seven other skeletons were found in the mound, the smallest of which measured eight feet, while others reached the enormous length of ten feet. They were buried singly, or each in separate graves. Resting against one of the coffins was an engraved stone tablet (now in Cincinnati), from the characters on which Dr. Everhart and Mr. Bowers are led to conclude that this giant race were sun worshippers.

The Island of Rapa Nui owes its interest to its mysterious relics of a forgotten race, who have utterly and completely died out even from legendary lore, while their handiwork abides, written on the rocks, which are so covered with carving as to resemble the studio of some giant sculptor. Colossal stone images lie half buried beneath the creeping grass and encroaching scrub. At intervals, all round the coast, there are Cyclopean platforms, from 200 ft. to 300 ft. in length, and about 30 ft. high, all built of hewn stones 5 ft. or 6 ft. long—and accurately fitted without cement—and above these, on the headlands, are artificially levelled platforms, paved with square blocks of black lava. On all these, stone pedestals remain, whereon were placed the great images which, by some powerful force, have mostly been

thrown to the ground and broken. The average height of the figures is about 18 ft.; some of those lying prostrate are 27 ft. long, and measure 8 ft. across the breast. You can infer the size of some of the upright ones from the fact that at so near noon as 2 p.m. they cast sufficient shadow to cover a party of thirty persons. Some have been found which measure 37 ft. They are all hewn of a close grained grey lava, which is only found at Otouli, a crater, on the east side of the island. On a platform near this quarry several gigantic images stand in perfect preservation. One of these measures 20 ft. from the shoulder to the crown of the head. They represent an unknown type. Very square face—short thin upper lip, giving a somewhat scornful expression—broad nose, and ears with pendant lobes. All the faces look upward. The eyes are deeply sunken, and are supposed to have originally had eye-balls of obsidian. All the principal images have the top of the head cut flat, and crowned with a cylindrical mass of red lava, hewn perfectly round. Some of these crowns are 66 in. in diameter, and 15 in. in height. The statues are literally lying about in hundreds, and the very rocks on the sea beach are carved into strange forms—tortoises or human faces.—*Leisure Hour.*

When Hanno, the Carthaginean, led his great colony along the shores of Africa, on the West, they met with beings so curiously made and covered with hair. that the Phœnician General was anxious to carry specimens of this race of men to Carthage, but from the trouble he had with them, and their ferocity, he was obliged to kill them on the journey.

The Crowfoot Indians of America formerly lived in dark caves and swamps and crawled on their hands and knees, fed on serpents, frogs, and worms, &c. They had hair on their bodies, and much resembled crawfish, and did not understand each other, and were shy and fearful to look upon. The Chocktaws first taught them to speak and walk on two legs.—*B. Möllhausen's Diary from Mississippi to the Pacific* (1858).

On the Island of Borneo has been found a certain race of wild creatures, of which kindred varieties have been discovered in the Phillipine Islands, in Terra del Fuego, and in South America. They walked unusually, almost erect, on two legs, and in that attitude measured about four feet in height. They are dark, wrinkled, and hairy. They construct no habitations, form no families, scarcely associate together, sleep in caves and trees, feed on snakes and vermin, on ants, eggs, and on each other. They cannot be tamed or forced to any labour, and are hunted among the trees like the great gorilla, of which they are a stunted copy. When captured alive, one finds, with surprise, that their uncouth jabbering sounds are like articulate language. They turn up a human face to gaze at their captors, and females show instincts of modesty; and, in fine, these wretched beings are men.

The Plesiosaurus is now disappearing, and the Pleiosaurus now appears somewhat resembling it. All these peculiar reptiles are giving place to the modern lizard and crocodile, while the serpent and crocodile replace the Icthyosaurus. We now find thirteen species of fossil birds, some with beaks and rows of teeth as regular and definite as are those of reptiles. The teeth are true enamel. They were sometimes planted in a row of distinct sockets, whilst in others they are fixed in a groove, which shows a gradual approximation towards development of sockets. These teeth belonged to Carnivora. One bird could not fly,—wings were rudimentary, even more so than the apteryx or penguin: it was between a bird and a reptile, and showed that the extremity of the upper jaw of this species had no teeth, but jaw terminated in a horny beak: here we had reptilian tooth, with beak of an ordinary bird; gradually in ages the beak grows bigger, teeth less, until finally they disappear and give origin to our modern race.

In a thousand more years I revisit the old haunts, and I find the horse now enjoying another change of foot with two splint bones; and the young deer were returning to visit their early miocenic ancestors with no horns.

Again a thousand years elapsed, and I revisited the country, and a village had been built on the sea-shore, and its inhabitants supported themselves by fishing, and they had erected a temple on the neighbouring hill, and dedicated it to their patron saint or God* of Plenty. And the adjacent country was studded with towns and villages—and the downs were covered with flocks and the valleys with herds, and the corn-fields and pastures were in a high state of cultivation, denoting an industrious and peaceful community. And lastly, after an interval of many centuries, I arrived once more, and the village was swept away, and its site covered by the waves,—but in the

* The Persians adored one Supreme God; him they saw visibly revealed in the sky, which, as the grandest known existence, they endowed with the highest known qualities—life and personality; and to him they gave such names as Varana, Ouranos, the enclosing one; or Dyaus, Deus, Teus, the shining one.

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valley and outer hills above the cliffs a beautiful city appeared, with its palaces, its temples, and its thousand edifices, and its streets teeming with a busy population in the highest state of civilisation—the resort of the nobles of the land, the residence of the monarch of a mighty main and lord of animal creation.

QUATERNARY.

SECOND AGE OF MAN.

Autocene.	Holocene.	Pleistocene.	Ice-Period.
Alluvium. Age of Metals.	Peat-beds. Neolithic implements. Mastodon.	Gravel-beds. Paleolithic implements. Horse.	Unstratified drift. Paleolithic implements. Reindeer.

Prof. Owen's Table pointing out the Connexion of the Several Orders of Mammalia at the points most nearly Related to Inferior Vertebrata.

Bimana
|
Quadrumana

Galeopithecus | Cheroptea Insectivora Pterodactylus | Aves	Lemur | Carnivora | Otario | Cetacea | Ichthyosaurus | Pisces	Bradypus | Edentata | Glyptodon Pachydermata	Cheiromys | Rodentia Toxodon Moschus | Ruminantia	Diadelphus | Marsupalia | Monotremata | Reptilia

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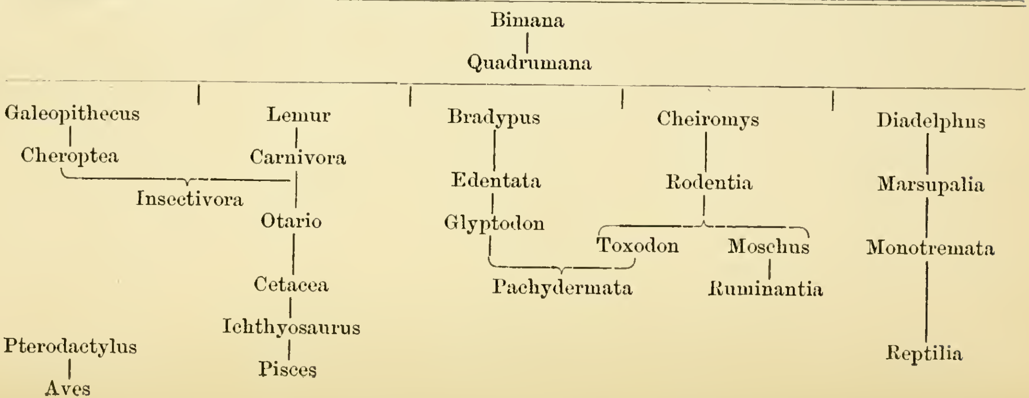

ORIGIN OF ORGANIC MATTER.

Todd and Bowman say *Organic Matter* derives vital properties in by far the majority of instances, and probably in all, from a previously exisiting organism, whilst Buffon supposed organic matter was originally produced from its elements independently of inorganic matter; but this idea is disproved by geological researches, which exhibit the universal fact of the primitive strata never containing organic remains. The question has often been agitated whether organic matter might not be spontaneously produced by some accidental meeting together of the chemical elements, carbon, hydrogen, oxygen, and nitrogen, without the necessity for a special apparatus for its creation. This idea has been maintained, from the circumstance that Urea and Alloxan, two animal matters, can be artificially produced by the chemist; and it was urged, the same might possibly be true of all organic matter. But it is to be observed that neither Urea nor Alloxan are true organic proximate elements; they are only the *products* of the decomposition of organic matter, and merely its intermediate state, before it passes into its original ultimate elements.

In the nourishment of plants, we find that Urea and Alloxan dispose the elements of dextrine to unite with the nitrogen of the ammonia, which had been previously received into the interior of the vegetable cell; which nitrogen, in its nascent state, uniting with the dextrine, converts it into vegetable protein matter (vegetable albumen, gluten, &c.); the sulphur and phosphorus necessary to its constitution being derived from the earthly sulphates and phosphates taken up from the soil at the same time as the ammonia.

Now sap, in ascending from cell to cell, undergoes a higher elaboration, forming successive new products, such as the acids, gums, resins, &c., which are deposited in different parts of the plant.

The various forces here brought into play are heat, light, endosmose, and the molecular forces. From the above-named changes, it is seen that vegetables are the true manufactures of protein or animal matter. Animals really originate nothing; the animal cell, however, possesses the exclusive power of modifying all matter presented to it, and transforming it into dextrine—which, when so formed, the whole amylaceous series, comprising starch, cellulose, gum, and sugar, may be considered as likewise produced, since these bodies are all isomeric. And from these the vegetable acids are formed by the simple addition of oxygen; whilst the vegetable oils and resins are produced from the same source by the abstraction of oxygen.

In viewing an organised body I must consider that an organism develops, much like a world out of an homogeneous and diffused state of its elements. Throughout its course the organic aggregate behaves like other aggregates. From the imperceptible it becomes perceptible. From the diffuse it becomes concentrated. From the indefinite it becomes definite. From the homogeneous it becomes heterogeneous. From the unstable it approaches the stable condition. Segregation, which is the selective process, is more marked in the organic than in the inorganic aggregate Its parts are differentiated and rendered distinct and definite, while through an increasing dependence between them the whole aggregate becomes more and more firmly integrated or consolidated. Growth, which is increase of bulk, is simply the absorption of diffuse gaseous or liquid materials, which may theoretically be regarded as having originally belonged to the aggregate in its most widely diffused condition. Development, which increases in structure, is the same process which all aggregates undergo in their transition from the homogeneous and indefinite toward the heterogeneous and

definite, under the laws of segregation and the multiplication of effects. Finally, equilibration in organic aggregates is distinct and universal.

Every organism must reach this stage, and that in a comparatively brief period—so brief as to be capable of repeated and easy observation. So plain does this stage of its progress become that it is feared that the predication of a stage of equilibration, not to say dissolution, for in organic aggregates, is an argument from analogy, where the analogy is taken from a very subordinate class of phenomena, viz., from the observed equilibration of organic aggregates. A universal conclusion is deduced from a particular case; the law of the whole is assumed from that of a part. This, according to Mr. Spencer's own showing, in his "Principles of Psychology," is the weakest form of reasoning. It should be admitted, however, that while the doctrine of the ultimate disintegration and dissolution of the celestial bodies rests on every insufficient inductive evidence, there are strong *apriori* grounds, beyond the domain of science, but clearly within the range of philosophy, which make it a legitimate object for the exercise of the "constructive imagination."

The most important truth which can be called in to aid us in this difficulty and apparent confusion of phenomena is that of the perpetual competitive operation of both the forces of evolution and of dissolution. Both these influences are at all times and in all kinds of aggregates simultaneously at work. The history of every aggregate is that of its struggle with these opposite contending influences. The final equilibration implies this. It is the establishment of equilibrium between just these forces. In evolution of a star the forces of dissolution are mostly within the aggregate. In that of a star-system they seem to be wholly so. The process of evolution goes on against the inherent tendencies to dissolution. The equilibrium reached is between the attractive or integrating and the repulsive or disintegrating forces. Both are at all times active, and if the latter at last prevail and the mode of redistribution is reversed, the gravitative in-

fluence still continues to oppose its progress. In an organism the disintegrating tendencies are chiefly from without. Everywhere on the globe the sun's influence is tending to prevent the integration of the liquid and gaseous elements. Life is the product of this struggle.

It may be laid down, as a universal law of the redistribution of matter, that organisation is the product of the antagonistic tendencies of attraction and repulsion during the period in which the former prevails. Organisation is, then, the great distinguishing characteristic of the process of evolution. The organisation of the solar system is the result of this competitive struggle between these two agencies. It is the same with an organism. We have, then, at last reached a plane of generalization in which the cosmical and the organic processes may be regarded as parallel and homologous throughout. The active principle which directly results in organisation is that which Mr. Spencer denominates *Segregation*, by which the like parts are brought together and unlike parts separated.

The final result of this process is that the formation of many distinct and definite parts are unlike one another—heterogeneous. Each of these definite parts, differing from all the rest in the same aggregate, is, within itself, homogeneous, *i.e.*, consists of a uniform internal structure. The like particles, in consequence of the similarity of their properties, naturally gravitate to the same place. In the case of the earth the atmosphere or gaseous portion forms a uniform envelope around it, due clearly to the nature and homogenity of its molecular constitution. The waters, for the same reason, form a partial second envelope within this. The hardened crust of solid matter comes next, and in like manner the entire organisation of the earth might be explained. Exactly the same process takes place in a living organisation. Its various organs, vessels, specialized tissues, and differentiated parts, are the result of this same law of mechanical selection. The difference in the properties of the matter of each is at once the cause of their segregation and of their organic function.

The point at which we have arrived, therefore, is this:

organization is the necessary consequence of the competition of the integrating and disintegrating forces, so long as the former prevail. The influence of the sun upon the matter of the globe is toward its disintegration and dissipation into gas. But for the opposing influence of gravitation, attraction, or concentration, this result would be speedily accomplished. But the resultant of these two antagonistic forces, at a time when their relative power is substantially what it now is on the surface of our globe, is such as to render possible the form of evolution which we denominate organic life.

Aristotle attributed the organisation of animals and vegetables, and the vital actions exhibited by them, to a series of animating principles (ψυχαι) differing according to the nature of the organised bodies constructed by them, and acting under the direction of the Supreme Animating Principle (φυσις). He supposed each particular kind of organised body had its proper animating principle, or ψυχη, and that variety of form depended upon certain original difference in the nature of the latter, so that every distinct species of animating principles would consequently have its appropriate species of body.

Harvey also assumed the existence of an *animating* principle, by which every organism is moulded into shape out of materials furnished by the parent, and which pervading substance regulates the various functions of its corporeal existence. He, however, at a subsequent stage of enquiries, in assigning the blood as the special seat of this principle, advanced another supposition quite at variance with the former hypotheses, namely, that as, during the development of a chick in ova, the blood is formed and moved before any vessel or any organ of motion exists, so in it and from it originate not only motion and pulsation, but animal temperature, the animal spirit, and even the *principle of life itself.*

John Hunter revived a somewhat similar hypothesis: his view was, that a prolific egg will remain sweet in a

warm atmosphere, while an unfecundated one will putrefy.

Hunter ascribes the phenomena of life to a *materia vitæ*, diffused through the solids and fluids of the body. This *materia vitæ* he considers to be "similar to the materials of the brain," and distinguishes it from the brain by the title "*materia vitæ diffusa*," while he calls that organ "*materia vitæ coacervata*," and supposes that it communicates with the former through the nerves, *Chordæ internunciæ*. And Abernethy, in commenting upon these views, explains Mr. Hunter's "*Materia vitæ*" to be a subtle substance, of a quickly and powerfully mobile nature, which is superadded to organisation and pervades organised bodies; and this he regards as at least of a nature similar to electricity. Muller advocates the presence of an "*Organic force*" resident in the whole organism, on which the existence of each part depends, and which has the property of generating from organic matter the individual organs necessary to the whole. "This rational creative force is exerted in every animal strictly in accordance with what the nature of each requires; it exists already in the germ and creates in it the essential parts of the future animal."

Dr. Prout asserts that a certain *organic agent* (or *agents*) exists, the intimate nature of which is not known, but to which extraordinary powers belong. It being superior to those agents whose operations we witness in the organic world, it possesses the power of controlling and directing the operations of those inferior agents. "*If*," says Prout, "the existence of one such organic agent be admitted, the admission of the existence of others can scarcely be withheld; *for the existence of the one only* is quite inadequate to explain the infinite diversity among plants and animals."

The hypotheses of Aristotle, Muller, Prout, and the earlier of those proposed by Harvey seem all alike; they assume that Organisation and Life are directed and controlled by an *Entity* or *Power* "endowed with a faculty little short of intelligence," the ψυχαι of Aristotle, the

organization is the necessary consequence of the competition of the integrating and disintegrating forces, so long as the former prevail. The influence of the sun upon the matter of the globe is toward its disintegration and dissipation into gas. But for the opposing influence of gravitation, attraction, or concentration, this result would be speedily accomplished. But the resultant of these two antagonistic forces, at a time when their relative power is substantially what it now is on the surface of our globe, is such as to render possible the form of evolution which we denominate organic life.

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animating principle of Harvey, the organic force of Muller, and the organic agent of Prout.

What that mechanism may be by which this entity acts they do not determine; but it is evident it is such as bears no analogy to any known natural cause.

It may, however, be held as an opinion that as various bodies are formed by the combination which carbon, hydrogen, nitrogen, and oxygen hold in compounds, so may the most perfect development of bodies and tissues, even life itself, be formed.

Electricity may play an important part amongst the gaseous bodies in the transformations and changes which occur.

The "*Materia vitæ diffusa*" of Hunter, mentioned above, may be considered as a modified form of electricity (now called etheric force), which modifying form has peculiarly vivifying properties unknown to us of the present day.

WHAT IS MATTER?*

"Fill thy heart with it," said Goethe, "and then name it as thou wilt."

Matter is a self-organising organism, or ever-evolving organism, evolving various bodies with ever-changing properties *ad infinitum.*

It was a favorite theory of Boscovich, the Roman mathematician of the last century, that all matter is only a congery of force-centres, separated by interstices or spaces of variable dimensions. These centres are either attractive or repellent. The theory, which he reduced to mathematical calculation, and illustrated by a curved line, served in his hands to account for many facts connected with cohesive attraction and the internal constitution of material bodies. It might not improbably be extended to all attractions, even to that of universal gravitation. Our own Faraday was at one time much taken with the theory, which pointed in his favorite direction of simplifying the laws of natural phenomena. He was met, however, by a difficulty, viz., if all bodies are alike—centres

* Whatever be the elementary principle or entity existing from eternity, and out of which matter and the phenomenal world assume its present form, it cannot be inactive, can never have existed originally in a state of rest.

Matter in its crude form has given origin to all the various elements.

When we have integration of matter, we have retained motion, and this retained motion undergoes a parallel transformation. It exists the same as heat in integrated bodies.

Concentration of matter implies dissipation of motion, and conversely, absorption of motion implies diffusion of matter.

The various empressments of matter depend entirely on molecular changes.

of force, and nothing more existing, in empty spaces,—how comes it that certain bodies called conductors afford an easy passage for a current of electricity, while others termed non-conductors, effectually obstruct its passage? The philosopher did not see his way through the difficulty, and, not without regret, laid aside the theory. Yet it is not altogether beyond possibility that the disposition of the force-centres may vary in two classes of bodies, so as, in those termed non-conducting, either to present to the electric current an impenetrable rampart of repellent forces, or, possibly, to scatter and dissipate it, so that it shall never emerge collectively as it entered. The objection is certainly not conclusive; it would be premature, solely on account of it, to deny the possible truth of the theory. It is well known that, in certain crystalline [a]

(a) Take away from matter all the power of resistance of solidity, *i.e.*, the cause of impenetrability, the power of attraction, repulsion, gravitation, chemical affinity, and what will remain? Nothing. You may say substance, but pray what is substance? Without power to resist, or to bear up, it would not even serve us for a substratum.

Just as every body and all material things are ultimately composed of the *most minute* particles, atoms, so every operation, motion, &c., in nature, when traced to its deepest source, is brought about by the *most minute efforts*. If we wish to comprehend the Almighty and imposing machinery of Nature, in fact the power which holds "the earth a sphere and guides the planets in their course," you must study, analyze, and comprehend these minute efforts and compound actions, which will ultimately lead you to immaterial power-points of effort-exertion

Matter being illimitable so would the power of producing infinite varieties be illimitable. Even we are forced to surmise that the dark thread, known as evil, is one which is intimately and deeply woven into that garment of God, called the universe, and as the universe is eternal, so is evil—we cannot imagine a Universe without a Gehenna; and as an All-goodness exists, so should an Eblos be co-eval as a contrast.

Elohim in his wisdom, however, is very sparing of miracles, although he could have saved Noe without an ark. Yet he prefers his own laws, which he had laid down before the foundation of the world was established. He prefers the laws of Nature; he respects Physiology, as much as he does Hydrostatics, hence he paired the Animals, two and two, the same with Adam as at the time of Deucalion's flood. N. C.

bodies, a much freer passage is offered to light, heat, and electricity in one direction than in another in the same crystal ; a difference depending on the position of its axis relatively to the direction of the force.

It is thoroughly understood that molecules or monits* of matter have a certain magnitude, however minute that may be, and hold latent heat in their interstices. It is now argued, with probability, that their magnitudes are in all cases equal. An approximate estimate of their size has been reached, chiefly by experiments on the relation of light to their films, and the diameter of a gaseous molecule has been calculated not to exceed the one five hundred millionth of an inch. A cubic inch of gas, at freezing temperature, and under an atmospheric pressure of thirty inches, contains about one hundred thousand million million million molecules, or ten raised to the twenty-third power.

A remark of Sir William Thomson's on this subject suggests a novel view to tyros in physics:—"If a sphere of water the size of a pea was expanded to the dimensions of the globe we live on, each molecule in it being similarly expanded, then the sphere so enlarged would be of coarser grain than a heap of small shot, but less coarse in grain than a heap of cricket balls."

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* A monit of matter, if sufficiently expanded into gaseous elements, may become so attenuated as not only to become invisible to the power of the spectroscope, but even to wander in space, without gravitation or any fixed law to guide it, and be considered a force point erratic on the confines of space; a number thus wandering may be considered congeries of force points, and acting as radii to each other, having a continual rotatory motion.

Faraday, when speaking about atoms, says, "To my mind, the nucleus vanishes, and the substance consists of power."

Primitive power generally, as well as *power-points, i.e.,* power in its least intensity, may be considered as an increasing exercise of a kind of potent *will* or *effort* upon something to be acted upon; yet not a clear *will* or *effort* consciously directing with intelligent design, but a crude unconscious effort steadily exerting itself and endeavouring to perform unswervingly its own peculiar function, and thus is inimitable in its character.

Helmholtz and Sir W. Thomson conceive that the ultimate molecules, or atoms of all matter, may have been evolved with a vortex-motion out of an incompressible ether, which is destitute of friction, or nearly so. What is meant by vortex-motion is represented on a large scale by the ring which rolls away from the mouth of a cannon when it is discharged on a still day. The advocates of this theory of the evolution of matter from ether apply it to explain very many of the physical properties of matter. If the ether in which the molecules of matter are moving, as described is devoid of friction (a supposition as purely theoretical as that of a line without breadth, or a surface without thickness), then the vortex-motion will go on for ever, and the vortex-motion might be conceived to be indestructible. But let ever so little friction enter into the conditions of the question, then sooner or later the end must come, and the vortex-atom must perish. The theory is abstruse in conception, certainly, and perhaps is capable of giving no more than an approximately true account of physical operations. It points, however, to profound views, and in able hands may be of good service to philosophy.[b]

The combination of atom matter forms various assemblages: one result appears as water, another as fire, another as animal or man, other atomic combinations form brain,—and from brain originate ideas, thought, instinct, passion, &c., they being the concomitant effects of organised substances.

Is life a process of dissolution? Is organic evolution a misnomer? Are the unfolding of the bud, the branching

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([b]) The atom of yesterday in corn is assimilated in animals, then may become a part of man, and thereafter may originate an idea which, incarnated, may overturn kingdoms and empires; and inversely—

> "Imperial Cæsar, dead and turned to clay,"

may reappear in Cæsar the house-dog.

> "Nothing of him that doth fade
> But doth suffer a sea-change
> Into something new and strange."
>
> SHAKSP., "Ariel."

of the tree, the hatching of the egg, the differentiation of the animal—are these but so many steps which concentrated matter is taking towards its final disintegration? Is development the antithesis of evolution? To all these questions a negative answer may be given.

Who knows the capabilities of matter so perfectly, as to be able to say that it can see, hear, smell, taste, and feel, but cannot possibly reflect, imagine, judge, &c.? Who has appreciated them so exactly as to be able to decide, that it can execute the mental functions of an elephant, a dog, or an orang outang, but cannot perform those of a Negro or Hottentot? If the mental processes be not a function of the brain, what is its office? In animals which possess only a small part of the human cerebral structure, sensation, and instincts exist, and in many cases is more acute than in man.* What employment shall we find for all that man possesses over and above this portion? Are we to believe those large and prodigiously developed human hemispheres only serve to round the figure of the organ, or to fill the cranium. A wound, a blow, pressure of blood, or fluids, *coup de soleil*, or any instrument or foreign body, impinging on the brain, whether on the cerebrum or cerebellum, may cause such a variety of nonsensical phenomena, that, if the thoughts and actions do not emanate from the brain, or material matter, we can only ascribe them to the soul, as being possessed with devils.

Take away from man's mind, or any animal, the operation of the five external senses, and the function of the brain—what will be left behind. Examine mind—the grand prerogative of man—where is the mind of the child just born—the five external senses act and grow by slow process to perfect expansion of adult faculties, and are annihilated for a short time by a blow, or apoplexy—where then is proof of the mind's independence of the bodily structure? The mind infantile in child, manly in

* "Thus by examples clear and plain,
We for these poor creatures claim
Sense to think, reflect, and plan,
And in their actions rival man.
Their guide—not instinct blind alone,
But reason, somewhat like our own."

adult, sick and debilitated in disease, frenzied in madness, enfeebled in declining years, and doting in decrepitude, and annihilated by death, all depends on brain structure.

The Mygale spider, not only possesses a well-organised brain, but is also gifted with certain organs of sense, really wonderful which admirably aid industry and intelligence. (Intellig. of Animals, p. 14.)

Let the mind of your bosom friend, or your pet parson, but be clothed in the canine shape, and judge him from the "dumb animal" point of view, you would soon think him a very stupid dog indeed. Let the spider's mind inhabit the body of a fisherman, or trapper, and you would own him as a "brother," and loudly extol his wond'rous skill and fertile invention—yet in the dark small body, you will even deny that he has a mind at all. How you would deride the folly of a man who judged of the goodness of a watch by the appearance of the case—or of a book by the pattern of its cover, yet such is your judgment of your brother animals.

The atomic movements are included in the general law of the unity of physical forces, but how powerless they still are to permit us to note exactly all the transformations of the molecular movements which take place in the interior of organised bodies.

Chemical combinations also obey the great law of the correlation of physical forces. It is clear that every chemical combination or de-combination reduces itself essentially to movements of atoms and molecules. In every chemical combination millions of atoms are precipitated towards each other, till they have reached a state of stable equilibrium.

The alimentary matters introduced into the animal organism represent molecular systems containing forces of tension, that is to say, group of molecules, in which the atomatic attractions mutually balance each other. When the matters enter the system they become oxidised, and then their molecular equilibrium is destroyed; they then set at liberty vital forces (free living forces), that

is to say, that the molecular attraction no longer neutralise each other; the atomic movements may be communicated to the ambient medium, and consequently be transformed into heat, into electricity, into movements, mechanical or of totality.

All the acts, all the movements, all the facts of consciousness of animals and of man are, at least in a considerable degree, transformations of solar energy.[c]

In material conditions we find the origin of all religions, philosophies, opinions, virtues, all spiritual conditions and influences. Nothing else exists than the above; forasmuch as generation cannot arise from that which is not, while likewise what exists cannot cease to be, for matter is indestructible, and atoms cannot change, nor

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(c) Essence of matter is etherial and thinking—it is Nature's God.

Tyndall considers matter essentially mystical and transcendental. He says:—" I discern in matter the promise and potency of every form and quality of life." He thinks our definitions of matter and force must be altered, since life and thought are the flower of both.

"If these statements startle it is because matter has been defined and maligned by philosophers and theologians, who were equally unaware that it is, at bottom, essentially mystical and transcendental."

Professor Bain considers matter as being both physical and mental, or a double-faced unity, having two sets of properties, or two sides—the physical and the mental,—but is, nevertheless, one substance. And the soul's thoughts, if any, are in some sense secreted by the brain in a similar manner as electricity is by the cells of the torpedo fish.

Dr. Buckner says—" It is by brain that we ascend from matter to mind."

The brain may change from health to disease, and, through such change the most exemplary man may be converted into a debauche or a murderer.

The scars of thought or memory on the brain resemble the scars on the living flesh, which is continually changing its composition. It resembles a kaleidoscope, in which the scene is perpetually changing.

> "I stand on the mount of a myriad years,
> And view, with a prophet's ken,
> The course of this onrushing world to its goal,—
> The fate of its future men."

alter, nor suffer, they having an unalterable and indestructible property given to them at their creation. Tyndal thinks emotion, intellect, will, thought, and all their phenomena, &c., were once latent in a fiery cloud, and may have existed first potentially in the primordial formless fog.

How long matter has existed, or when this Earth will be annihilated (uninhabitable or changed) is known to no mortal being; but if for curiosity we read the "Brahmagala-sutra," a destruction of the world occurs at the end of every Kalpa, a destruction which not only annihilates Earth and hell, but the worlds of the gods. The length of a Kalpa can only be expressed in the language of Buddhism. Imagine a cube of fifty miles of stone. Let this stone be rubbed with a fine piece of cloth once in five hundred years. The stone will be completely rubbed away by the cloth before a Kalpa will have passed away.

Le Place and others admit no necessity for a deity to originate matter, or its laws. Le Place showed how nebulous matter, placed in certain positions, and having a certain revolution, might be separated into suns and planets by merely mechanical laws, and that matter produces life in an agglomeration of the molecules. But Bury St. Vincent would not hazard such an opinion, for he says—"Since these laws will always be imperfectly known, it will be at least rash to maintain that an infinite intelligence did not impose them, since they are manifested by their results." (Dict. Claes, D'Hist. Nat.)—Matiere.

The present theory of the 19th century is that the [d] Earth was formerly in the state of an incandescent globe; that during numerous cycles it was absolutely uninhabitable for the organised world we now know.

(d) "The Earth," says Leibnitz (Protogœa), "is an extinguished sun, a vitrified globe, on which the vapors, falling down again after it had cooled, formed seas, which afterwards deposited the limestone formations."

"The whole globe," says Demaillet, "was covered with water many thousand years. The water gradually retired. All the land animals were originally inhabitants of the sea. Man

In the cooling of our globe, possibly one fortuitous cell may have been formed which gave origin to organic life, and led to startling events in peopling this Earth—even Hæckel's monads may have been formed from developed heat by attrition.

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was originally a fish; and there are still fish to be met with in the ocean which are half men, on their progress to the perfect human shape, and whose descendants will in process of time become men."

Buffon's "Théorie" is: "The Earth was a fragment of the Sun, struck off red-hot by the blow of a comet, together with all the other planets, which were also red-hot fragments. The age of the world, then, can be calculated from the number of years which it would take to cool so large a mass from a red-hot state down to its present temperature. But it is, of course, growing colder every year; and, as well as the other planets, must finally be a globe of ice."

Lamarck says: "All things were originally fluid. The waters gave birth to microscopic insects; the insect, in the course of ages, magnified themselves into the larger animals; the animals, in the course of ages, converted a portion of the water into calcareous earth; the vegetables converted another portion into clay! The two substances, in the course of ages, converted themselves into silex; and thus the silicious mountains are the oldest of all. All the solid parts of the Earth, therefore, owe their existence to life; and without life, the globe would be entirely liquid." This, too, is the favourite mode among the "German philosophers" of accounting for the formation and filling of the world.

"The Earth," says Patrin, Dict. d'Histoire Naturelle, "is a great animal; it is alive; a vital fluid circulates in it; every particle of it is alive; it has instinct and volition, even to the most elementary molecules, which attract and repel each other according to sympathies and antipathies. Every mineral has the power of converting immense masses into its own nature as we convert food into flesh and blood. The mountains are the respiratory organs of the globe! The schists are the organs of secretion; the mineral veins are 'abscesses;' and the metals are products of disease, for which reason most of them have repulsive smell."

The Earth again may be said to be a large living globular animal, the mountains being its back-bone, the rivers its arteries, the sea its heart, the trees its hair, and living beings the pœdicula existing on its back, the various metals abnormal changes going on in its system, the earthquakes a feverish state of excitement, whilst volcanoes would be the eructations of a bilious disordered stomach.—N.C.

Oken thought the formation of matter to be "all done by polarisation."

Allowing the Earth, according to the present theory, to have been in a gaseous or molten state 500 millions of years ago, may it not appear feasible that, on the condensation of the various gaseous elements a solidification of them would form visible matter, and that those bodies called C,H,N,O, viewed by us as elements may be compounds, and, by decomposition and separation of their various atoms, may have originated all the so-called simple elements known to us of the present day.

LAWS OF MATTER.

"The whole universe of matter is a great mundane psalm to celebrate the reign of Power, Law, and Mind. Fly through the solar system from remotest Neptune to the Sun, study each planet, it is the same. Ask every little orange-leaf, ask the aphis that feeds thereon, ask the insect corpses lying by millions in the dead ashes of the farmer's peat-fire, the remains of molluscs that gave up the ghost millions of years before man trod the globe,—they all, with united voice, answer still the same—Power, Law, Mind. In all the space from Neptune to the Sun, in all time, from the silicious shell to the orange-leaf of to-day, there is no failure of that power, no break of that law, no cessation of its constant mode of operation, no error of that mind whereof all space is here, all time is now. So the world is witness continually to power, the never-failing law, to mind that is everywhere—is witness to that ever-present Power which men call God."*—T. Parker.

The laws that govern Nature[1] go on with a steady

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* The Hindoo's views of the God of Nature are that He is "*without name or color*, or *hands or feet*." It is the "*smallest of the least*," and "*largest of the large*." It "is *all*, and *knowing all things*. It hears without ears, sees without eyes, moves without hands."

(1) In all the operations of Nature.........God worked by law ....by the process of slow development, by means, beautiful

and unchangeable progression. They are established by one great Positive Power of Mind. This Power men call Deity, whose attributes are Love and Wisdom, corresponding with the principles of male and female, positive and negative, sustaining and creative. The growth of trees, of flowers, of animals, is invariably attended with chemical, mechanical, and physiological changes; hence the conclusion that the Diety is a substance moving substance; but the moving principle must be superior to that which is moved. Nature testifies most positively that she acts universally upon matter in six distinct but converging ways: first—anatomically; second—physiologically; third—mechanically; fourth — chemically; fifth — electrically; sixth — magnetically. The anatomy, physiology, mechanism, and chemistry of the rose tend to a beauteous flower; although all these processes take place in the germ of the rose with the minutest and most distinct precision, yet there are but three actions or processes apparent—namely, Association, Progress, and unfolding, or Development; so with everything in Nature. The first three modes by which Nature acts, viz., the anatomical, physiological, and mechanical modes, are simply manifestations of the Principle of Motion; also the fourth and fifth modes—viz., the chemical and electrical—are manifestations of the Principle of Life; that the sixth—the magnetic action—is only another name for the Principle of *Sensation;* and if we admit a seventh, then it would be what we term Intelligence.

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and simple, involving no violence, no haste, yet irresistible.—*Quarterly Review.*

"Has this uniformity of Nature ever been broken? 'Not to the knowledge of Science.'"—(The Mail, Tyndall, 3rd October, 1877.)

One of the laws that govern Nature is Gravitation.

In Gravitation we have two acting powers;—1st, *Versatile Activity* dwelling in the ultimate *material particles* or monits, of which the earth is composed; the other, *end-unition,* inhering not only in the free ends of these *monits radii,* but also more especially in the lineits of the all-traversing *cosmolineæ*, which are ever present throughout the immensity of the universe, in and around the earth, and converging towards its centre.

Faraday thought that the proper study of forces might "perhaps enable us to know whether the essential force of gravi-

Motion, Life, Sensation, and Intelligence unfold themselves into an organisation of elementary principles, which govern all the vast matter we see in Nature. Motion was first especially manifested in the Mineral Kingdom; Life, in the Vegetable; Sensation, in the Animal; and Intelligence in the human; but as you ascend the successive kingdoms in the development of Nature, there you perceive these principles of action to be more progressive towards perfection.

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tation is internal or external, as respects the attracted bodies." By examining the subject according to the lineistic theory, we find the gravitation force is external with respect to attracted bodies, but internal with respect to the attracting bodies.

Euler and others raised the question as to the possibility of bodies existing without gravity. Before answering the question I must traverse the point as to the meaning of the word gravity. If gravity is conceived as being nothing more than a primary power or tendency in matter to press and fall towards other matter; this would presume on some occult quality, able first to find out the distance of any body of matter and its centre without any medium whatever—although immensely distant—and then to move in a peculiar and precise manner with a steadily-increasing ratio.

If by gravity we understand the mere phenomenon of the general approaching of all bodies, each one to all others, then we can in justice say bodies or matter still exist, even if gravity was non-existent, because if the medium is wanting to allow the approaching by drawing or pushing, the bodies cannot approach or gravitate even if the monits are ever so actively engaged in rotating. And in this case we would be justified in saying bodies may exist without gravity.

In an absolute vacuum, *i.e.*, a vacuum void of cosmolineæ, it would be impossible for material bodies to gravitate towards each other, no matter how active the minutest particles of these bodies may be in trying to produce the phenomena of gravitation.

No attraction of gravitation, no attractions nor repulsions of magnetism, of electricity, and molecular forces can at a distance —not even at the smallest measurable distance—be performed without a proper intervening medium.

No two bodies would gravitate in "pure and simple space" unless the versatile or rotatory activity inherent in monits shall set the cosmolineæ in motion and keep it moving, by which medium the bodies are attracted. In this sense gravity exists. Bodies would in this sense cease to be bodies with the cessation of all gravity.

Thus the vegetable is actuated, not only by motion but also by life; and the animal, not only by motion and life, but by sensation combined with them; and the human organisation is actuated by motion, life, and sensation, in a perfect state of combination, which combination developes mind and intelligence.

CONVERSION OF FORCE AND MATTER.

Dr. Carpenter thinks one force is converted into another through the medium of a certain form of matter, or *material substratum*,—as when electricity is converted into magnetism through iron, or heat into electricity through a combination of bismuth and antimony; so "all true vital phenomena, however diversified, are but results of the operation of one and the same force, whose particular manifestations are determined by the nature of the *material substratum* through which it acts; the same fundamental agency producing simple *growth* in one case, *transformation* in another, *multiplication* in a third, *mechanical movement* in a fourth, whilst in a fifth it developes *nervous power*, which may itself operate in a variety of different modes."

MOLECULAR MAGNITUDES OF MATTER.

The mathematical definition of a point consists in stating it as a locality without length, breadth, or thickness; but we receive no very concise idea of the definition until we proceed graphically, and make a dot with a pencil or otherwise, which shall possess limited dimensions of length and breadth; then, by the metaphysical process of abstraction, we dispense with the linear dimensions of length and breadth, and thus purify our conceptions in a way of realizing the entity of real existence of the invisibly small in Nature.

In the animal kingdom are found myriads of forms so minute* that their bulk is reckoned by less than the mil-

* So minute indeed, as even to elude Profs Tyndall's Spectroscopic tests.—N. C.

lionth part of a cubic inch, yet each one is endowed with organs of sense or assimilation sufficient to serve the purpose in their sphere of life. The vegetable kingdom, also, offers abundant specimens of microscopic forms, calculated to excite our admiration by the beauty and minuteness of their organisms. Such is notably the case in several forms of *Diatomaceæ.* The striated markings of *Pleurosigma fasciola* aggregate to 64,000 to the inch, while *Amphipleura pellucida* often exhibit striæ exceeding 100,000 to the lineal inch. And yet the skeletons of these minute organisms are composed mainly of silex, the silex again being made up of silicon and oxygen. Notwithstanding the almost infinitesimal magnitudes of the organic world, human skill is able to compete in the matter of minuteness. Platinum wire has been drawn so fine as to rival in minuteness the smallest fibre of the spider's web. Gold has been deposited upon the surface of other metals, and drawn to such extreme thinness that a thousand-millionth part of a grain exhibited the visible characteristics of the metal. The oscillations of the horizontal pendulum can be measured to the $\frac{1}{80000000}$ part of an inch, by the aid of a small mirror, a beam of light, and a graduated scale for reading the vibrations. Nobert, with a mechanical skill unsurpassed, has repeatedly ruled with a diamond-point upon glass the nineteenth band of his test-plate, consisting of lines less than the $\frac{1}{112000}$ of an inch apart, and it is claimed that he has succeeded in ruling plates covering 224,000 lines per inch, such as would aggregate in superficial areas over 50,000,000,000 to the square inch ! Such minute divisions are wholly beyond the resolving power of the most elaborate of modern microscopic appliances ; for it has been shown by Sorby (H. C. Sorby, F.R.S., in his anniversary address to the Royal Microscopical Society, in the *Quarterly Journal of Microscopical Science*, for April, 1876), that the ultimate power of the microscope for distinct definition is limited to the examination of magnitudes not less than one-half of the average wave-length of the luminous spectrum ; and it is shown, upon the authority of Helmholtz, that when the amplitude of the object is less

than this half wave-length—or somewhat in excess of 80,000 to the inch—the dark interference-fringes impair the definition of the instrument, except in the case of striated markings, which may be clearly defined, or resolved, by so arranging the illumination as to mask the fringes, and bring out a good definition even in excess of 100,000 to the inch. Hence, the main difficulty attending the possible amplification of objects less than about the $\frac{1}{100000}$ of an inch in diameter is a purely physical one, and depends upon the constitution of light itself.

The various phenomena of chemical physics teach us that matter is not homogeneous, but is made up of infinitesimal particles or atoms, the term *atom* meaning *indivisible particles;* and the term *molecule*—meaning literally *a little mass*—refers to an aggregation to two or more atoms. Thus, a crystal of common salt may be pulverized until one of its fragments is barely discernible to the highest range of microscopic power, and still this fragment will retain all the characteristics of salt. This same microscopic portion is susceptible of a further subdivision by solution in water, when the spectroscope will detect its presence in the still minuter quantity of the one-hundred-millionth part of a grain. Here, in the case of salt, physical analysis ends, and, aside from chemical analysis, any further subdivision must be by the process of abstraction, until by its means we arrive at the mental conception of a portion so minute as to consist of an atom of sodium united by the bonds of chemical affinity to an atom of chlorine. This is now a molecule of common salt. Any further division destroys the entity of the compound, and results in the decomposition of salt into the atoms of its elements. Hence a simple molecule is the smallest portion of any chemical compound that is not susceptible of subdivision without destroying its entity, or, in other words, the smallest number of atoms that can cohere to form a compound constitute the molecule of that compound. An atom is designated as the ultimate particle of any elementary body, and is not susceptible of any further division within the range of human analysis.

Were it possible to magnify the atoms of matter to a diameter available for distinct vision, we should be met at the outset by a difficulty too astounding for realization. It is a matter of easy proof that the magnifying of any object while in motion will exhibit that motion increased in velocity just as many times as the diameter of the object is augmented. Suppose we had at our command an instrument competent to amplify the atoms to the one-fiftieth of an inch in diameter: in the case of the hydrogen-atom the necessary magnifying power would be 10,000,000 diameters, under which power the atoms would have their motions enhanced by the same multiple, and we should then be called upon to examine an image the fiftieth part of an inch in diameter plunging across the field of vision five hundred million times faster than the flight of a cannon-ball.

It follows, since human skill is incompetent to penetrate by any mechanical means into the internal structure of matter, that we shall be compelled to direct our labors to other modes of investigation if we would know more of the atomic structure of matter, possessing as it does a minuteness far surpassing the analytical power of the microscope; in fact, so hopelessly ultra-microscopic as to elude all other processes except that of mathematics and experimental investigation.

The question of the infinitely large and the immeasurably small has engaged the attention of philosophers since the days of Democritus. Modern investigators are, however, in possession of experimental data that aid them in arriving at facts with ever-increasing accuracy. We have the atomic theory first placed upon a substantial basis by Dalton, which treats of the atomic constituents of matter, and gives to each atom a definite size and weight, and establishes the proposition that atoms combine to form molecules, and that molecules aggregate to masses. We have also the kinetic theory of gases, which has been placed upon a purely mathematico-scientific footing, as has also the department of hydro-kinetics; and experiments within these departments are accumulating evidence concerning the atomic and physical structure of matter.

The kinetic theories are based upon the conception that these particles or atoms are in constant motion among themselves; and it assumes, also, that their movements have an infinite series of velocities in all conceivable directions, but with varying degrees of intensity. This idea of atomic and molecular motion puts us in possession of an important factor for determining the causation of all physical phenomena. Of course we do not presume to say that the atom is the primordial or ultimate constituent of matter, for there are many evidences to show that the present list of sixty-five elements of matter may not be elementary at all, but isomeric compounds of one or more simpler constituents.

The question might here be asked, "How does the physicist know anything of the relative size of atoms and their vibratory motions?" The answer is: by mathematical deductions, based upon the behavior of gases; by experimental evidence, principally in the domain of radiant heat; also in the interdiffusion of liquids and gases. Researches in these departments have determined, with a great deal of certainty, that the atoms and molecules of matter do not touch each other, and that the various velocities they may assume under different conditions are the causes of all the phenomena of light and heat. And, moreover, it has been determined by the most refined experiments, with special instruments of precision, that these atoms have a definite size and weight, and, under special conditions, a definite velocity and momentum. The pressure of gases has also been defined as the resultant of the molecular bombardment or impact of these flying projectiles against the sides of the containing vessel.

"Some molecular data have been tabulated from the calculations of Clausius, Maxwell, Thomson, and others, but the figures given are wholly beyond human comprehension. Thus the number of atoms in one cubic inch of hydrogen-gas, at the temperature of freezing water and under the pressure of one atmosphere, is given in the neighborhood of three hundred trillion, each atom possessing an initial velocity of over a mile per second, cover-

ing nearly eighteen billions of oscillations in different directions in the same second of time. That is to say, each particle of hydrogen, while moving at the rate of seventy miles per minute, has its course wholly changed something like 17,700,000,000 times in every second. Sir William Thomson concludes, from the data given by Clausius, that the diameter of the gaseous molecule is somewhere between the $\frac{1}{250000000}$ and the $\frac{1}{500000000}$ of an inch, and as the density of known liquids and solids is from 500 to 16,000 times that of common air, he concludes that the distance from centre to centre of contiguous mole. cules in solids is less than the $\frac{1}{2500000000}$ and greater than the $\frac{1}{5000000000}$ of an inch; and he illustrates by supposing "a drop of water to be magnified up to the size of the earth, each molecule to be amplified in the same proportion, these molecules will then be less in size than cricket-balls, but larger than small lead-shot."

Imagine the particles of the air we breathe flying about at the rate of eighteen miles per minute—a velocity exceeding that of a cannon-ball—a velocity which, if the particles were all moving in one direction, would constitute a tornado ten times more violent than any terrestrial hurricane! How is it, then, that we can survive the incessant bombardment of such a storm of projectiles? Simply because the particles are moving in all directions, so as nearly to counterbalance each other's momentum. Were it not that the molecules are continually changing their direction by executing a sort of cannonade upon their neighbors, the interdiffusion of liquids and gases would be almost instantaneous. If the molecules could project in straight lines without interference with each other, the opening of a bottle of perfumery would permit the diffusion of its odor to the distance of many hundred feet sooner than you could open and recork the bottle, or, in some instances, about one-third of a mile in one second of time."—(Pop. Sc.)

Now, if we destroy the motion in atoms, heat will be the result, that is molecular motion is transformed into heat.

I may assume that heat has a backward as well as a forward motion, for nothing is clearer than that a heated body is not in motion as a whole, and will not move itself when placed on a table. Sound enters a substance or a man's ears, and passing backwards and forwards resembles heat entering a body, and becoming diffused throughout the entire article, but in no case is the man heavier from the sound, or the article from diffused heat.

Molecules are never at rest; they display an intense and ceaseless energy in their motions. There is a continual clashing together of these minute bodies, which are continually maimed, and yet recover themselves, until at last a blow is struck which dissevers the atoms which form a compound molecule. Then a new state of things sets in.

The simple atom, however, is an immortal being, and remains unaltered and essentially unaffected amid the powerful blows it receives. It no doubt is unceasingly active, and although may undergo some change of form, yet it always is the same.

Amidst all this warfare of clashing atoms, there are laws which determine the ultimate result of all these motions, taken together as a whole.

And although these minute parts which compose the *whole* are in a state of violent commotion, yet the system as a whole will remain at rest.

This may possibly give an explanation to the change in steel or iron, and in fact all metals, after being in use some time.

SPONTANEOUS GENERATION AND DIVISION.[c]

As spontaneous generation, or, in other words, immediate development of Bacteria from certain fluids has for some years been *sub judice*, I will give a few of Drs.

(c) " Even if we admit that the defenders of spontaneous genesis have generalised a little too much in the application of their doctrine; it is certain that on their sides there is the largest amount of truth."—LETOURNEAU'S BIOLOGY.

Bastain and Sanderson's experiments on the same. Dr. Sanderson disputed the results of Dr. Bastain's experiments on the beginnings of life, but has since made the same experiments himself with the same results as those obtained by Dr. Bastain, and comes forward to acknowledge his error. The opponents of the doctrine of spontaneous generation have always maintained that a certain degree of heat [cc] is destructive to animal life, although Infusoræ can resist a degree of cold equal to 8° F.,[d] and a degree of heat equal to 260° F., or even 300° F.,[d] and that if organic matter be heated to that degree, and then effectually secured from the admission of air, no signs of animal life will ever appear. Dr. Bastain declared that his experiments disproved this view, and now Dr. Sanderson admits that he was right. In certain infusions which had been calcined, and to which the external atmosphere had no access, there were found leptothrix and bacteria in abundance.

No one for a moment can doubt that there exists some relation, although not yet a known definite one, between the non-appearance of Bacteria in the twelve last experiments,[e] and the circumstances that these flasks had been exposed to a temperature of 101° C. Neither

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(cc) In smutty corn, anguillulæ without distinct organs have been found, and which, according to Mons. Duvaine, may be dried and revived eighteen times in succession. N.C.

(d) "In sixteen experiments the liquids were subjected to the temperature of boiling at the normal pressure. Of these, eight were heated for fifteen minutes, and all bred Bacteria; six were heated for thirty minutes, of which two bred Bacteria; two for an hour, both of which were barren."

"Of ten subjected to the temperature of ebullition at pressures not exceeding one inch, eight were barren. Both the liquids which were found to be pregnant had been heated for thirty minutes; one under a pressure of one-tenth of an inch, the other of one inch."

(e) "In twelve experiments in which the liquids were heated under pressures exceeding one inch, all were barren, although half of them were subjected to that temperature for only fifteen minutes."

can any one doubt that there was a relation between the facts that in eight flasks heated for only fifteen minutes Bacteria were found, whilst in two flasks heated for an hour Bacteria were not found. Whether the doctrine of spontaneous generation be true or not, we cannot suppose that chance has anything to do with the results. If it be true that Bacteria can be spontaneously generated in certain fluids, generation must still be subject to laws; and in Dr. Burdon-Sanderson's experiments we seem to be gaining a glimpse of one of the laws by which the production is governed. If, on the contrary, it be true that Bacteria[ee] can only be produced from pre-existent

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Dr. Sanderson thus concludes his letter :—

"It is unnecessary for me to draw any inferences from the preceding experiments. It may not, however, be superfluous to point out that although all the flasks heated above 101deg. C. remained sterile, this fact affords no ground for concluding that any definite relation exists between that precise temperature and the destruction of the germinating power of the liquid in question. All that has been shown is that the CHANCE that such a liquid will breed Bacteria is diminished either by slightly increasing the temperature to which it is heated or increasing the duration of the heating. Thus, it appears to me quite evident that if a certain number of flasks were heated even to 102deg. C., some of them would still be pregnant."

(ee) The demonstration of the intimate relation of bacteria to certain fevers and other diseases would seem at first sight to greatly simplify the work of the physician in searching for efficient remedies. Put in plain English the problem is to find some element or compound that is fatal to bacteria, and administer it in the best way calculated to reach the mischievous fungi in the patient's blood. But the problem is easier stated than solved. The lower forms of life which appear to cause the trouble are able to live and thrive under the widest possible range of condition; so that, so far as known, any reagents that will kill them would be much more quickly fatal to the patients.

The eminent English chemist, Edward Frankland, recounted at a meeting of the Society of Arts in 1882, some experiments made in his own laboratory, showing the indifference of bacteria to conditions that would speedily destroy higher organisms.

A quantity of mutton broth was affected by bacteria, and when swarming with these organisms, it was introduced into a vessel filled with mercury, and standing over that liquid. Then various

germs, Dr. Burdon-Sanderson's experiments go to establish the point at which heat,[f] either excessive or prolonged, will destroy those germs, or at least prevent their growth and multiplication. Whichever be the true explanation, it is of the greatest practical importance that the experiments should be conducted with an amount of care, and should be repeated a number of times, to exclude

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gases were put into these globes, and, of course, in contact with this liquid teeming with bacteria. Oxygen was tried, hydrogen, nitrogen, carbonic acid, and all the ordinary gases, some of which were believed to be beneficial to plants; but the bacteria seemed to delight equally in either of them. They got on quite as well in carbonic acid as they did in oxygen; they could live for weeks without the presence of a trace of oxygen in the liquid, with nothing but pure carbonic acid.

If the experiments had gone no further, they would show that these organisms had an extraordinary tenacity of life. But cyanogen was now introduced into the flasks, and, although they certainly did sicken a little under it, they recovered a little in the course of a week or so, and went on living in that gas in a fairly healthy condition. Sulphurous acid—the mutton broth itself being, of course, saturated with this gas, and the atmosphere of the glass globe consisting of nothing else but sulphurous acid—seemed to have very little effect on them at all; their motions were not stopped, and they seemed to be as lively after the application of it as before, and the same was the case with several other reagents which were tried.

(f) Fish live in the hot springs of Trincomalee, which has a temperature of 125deg. Fahrenheit, while the Helmet Crest, or Black Warrior bird (Oxypogon Linden) lives from 12 to 13,000 feet above the sea-level and just below the line of perpetual congelation. Glacier flies are also found there. Vegetation flourishes there, such as "Hypericum myrtus," daphne, arborescents "espeletias," &c., while at slightly lower elevations are found "bejarias."

"Those who believe that the centre of the Earth is exceedingly hot, so that all the substances composing it are molten, if not even vaporised by intensity of heat, may find their faith in some degree shaken by the results of deep-mining at Stawell, in Victoria. According to the rate at which the temperature has been observed to increase with depth in European mines, the lower part of the shaft sunk by the Magdala Quartz Company to a depth of 2,100ft. ought to be so hot that

everything like chance from the results. Whether life is ever kindling afresh around us, or whether it is only transmitted from one generation of animated beings to another, in either case the process can only be a regular one, possible only under what seem to be ascertainable conditions, and in no degree fortuitous.

Ehrenberg believes that in spite of desiccation the organised fluid still remains apparently dead animal, and can easily be vivified, although votifera had been heated in moistened sand to 130° . F. Doyere (p. 119) thinks it

the miners would barely be able to work. But the manager reports that when the thermometer was close to the bottom, the mercury stood only at 82deg. Fahrenheit, when suspended 10ft. from the bottom, at 80deg.; and in the chamber, at 74deg.; in the western drive, at 86deg. in the face; in the rise, where no air-pipes carry air, at 84deg.; and on the same afternoon the same glass showed the temperature inside the office, on the surface of the ground, to be 80deg. Science will have considerably to modify her interpretation of the great heat at the bottom of many European mines of no greater depth. If the whole central mass of the Earth were hot, an approach towards the centre by so many feet would produce about as much effect in one region as in another (excepting, of course, certain volcanic districts). The theory of local subterranean fires, other than those finding visible outlets, may remove this special difficulty, but introduces others scarcely less serious. If the increase of heat in European mines were limited to coal mines, the difficulty might perhaps be removed in another way, but this is not the case. In two shafts in coal mines in England, each about 2,000ft. deep, the temperature was found to increase by 1deg. Fahrenheit for every increase of depth of from 65ft. to 70ft.; and about exactly the same increase has been noticed in the principal lead and silver mines of Saxony. A thermometer fixed in the rock of the Dalcoath mine in Cornwall, at a depth of 1,380ft., showed a mean temperature for the year of 18deg. below that of the surface. Some observers estimate the rate of increase at 1deg. for 45ft. (M. Cordier's estimate), and others at so much as 1deg. in 37ft. But, taking only 1deg. in 70ft., the temperature at the bottom of the Stawell shaft should be 30deg. hotter than at the surface, whereas the difference is but a small fraction of this amount. Probably the true explanation of the matter is that, as Sir Charles Lyell long since suggested, "vast reservoirs of molten matter exist beneath the surface, but such, nevertheless, as may hold a very subordinate place in the Earth's crust."

loses its power.[g] Rotifera after $2\frac{1}{2}$ years can be brought to life.—(*Fontana Über das Wiperngift*).

Franz Bauer found *vibrio tritici* moved after being four years dried.

Baker (in 1771) resuscitated paste-eels, which Needham gave him in 1744.

Payen says that sporules of a minute fungus (*Oidium aurantiacum*), which covers bread with a reddish feathery coating, do not lose the power of germination by being exposed for half an hour, enclosed in tubes, to 207.5° F. before being strewn on fresh perfectly unspoiled dough.

This fungus may have a monad (*monas prodigiosa*). —MIGA.

The yellow sand or dust which falls like rain[h] in the Atlantic near Cape de Verd Islands is occasionally carried even to Italy and Europe: it consists of many sillicious-shelled microscopic animals Perhaps many float for years in the upper strata of the atmosphere, and are capable of revivication and multiplying species by spontaneous division.

Again, most organic bodies, macerated in a liquid of a suitable temperature, in a tolerable short time will develop vegetable and animal proto-organism.[i] Enemies

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(g) A first organism, says Spencer, is wholly at variance with evolution, the lowest living forms can scarcely be called organisms, for they have no distinction of parts, no traces of organisation. They change from moment to moment, and are never twice alike, either in two individuals or in the same individual."—SPENCER.

(h) The wind (Gharm-sal) "hot blast" blows almost daily at Kokand, producing a darkness from the air being loaded with the finest dust."—M. TEDCHENKE.

"An explicable dust, coming no one knows from where, falls. The dust is so dense that the Sun's rays cannot penetrate it, and this continues sometimes for 7 or 8 days."—DANIBEG GEOGRAPH. MAGAZ., June, 1876.

(i) "Forasmuch as the primary elementary forms of all organisms are cells, the fundamental source of all organisms reduces itself to the fundamental force of cells."—SCHWANN MIKROSKOPISCHE UNTERSUCHUNGEN, 1838.

to this view say they proceed from germs floating in the air. But who says germ says ovulum, that is to say, a cell of an appreciable diameter under the microscope. The ovulum of certain ciliated microzoa varies from $0,^{mm}0028$ to $0,^{mm}0420$ in diameter.

Examine the air microscopically, and it will be exceptional if we find the ovum of a ciliated microzoon or the spore of a mucedinale. In a fermented mixture of liquids, different beings will form wholly distinct from those bodies existing in the separate fluids.

In macerations of hay, according to Gerard, the following is the order of animals appearing in the fluids: —About the 2nd day, *bacterium*, termed simple; next, monads; about the 15th day, trichods, colpods, the proteus closing the series. The monads which appear in the infusion subsequently to the death of the vibrios are to be looked upon as, in some cases, at any rate, the embryonic, or larval forms of the higher Infusoria which finally appear are of a comparatively high grade of organisation, being certainly the highest of the Protozoa.

Some authorities believe that the bacteria are produced by the fusion together of the primitive molecules in twos and threes; and that the vibrios are produced out of the bacteria by the addition of fresh molecules to the extremities of the latter, or by their uniting with one another.

Under the epidermis of many living plants we find certain vegetal parasites develope themselves: whence come these seeds of entophytes which appear in plants destitute of stomata.

Microscopic mushrooms spring up and live in citrons. Hartig found some in the cavities of ligneous trees, under numerous sound animal layers. Marklin has shown that the white of an hen's egg, has been converted into *sporotrichum*. Vibrions have been found in the pus of a closed abscess.

M. Dujardin (*Histoire des Helminthes*), in speaking of *rhabditis asceti*, says they dwell exclusively in wine

vinegar, and are found neither in vine nor in grapes. I ask where were their germs, when man made neither wine nor vinegar?

The advocates of spontaneous generation, Abiogenesis, or Heterogenesis, affirm that the Infusoria which finally appear in the diffusion are produced spontaneously out of the molecular pellicle, the molecules of which are also of spontaneous origin, and are not derived from any existing germs.

INFUSORIA AND ANIMALCULÆ.

Monads, whose life may have commenced by the mere motion of a fluid body in the water, are as carnivorous and voracious as the highest-developed vertebrate carnivora on land;[j] they prey on smaller animals, and they are amongst the smallest atoms of matter known to us microscopically as possessing life. They are of various colors, red, green, or yellow.

Sheppard found a specimen of a monad which stained paper red, blue, and purple, and the whole clot appeared like coagulated blood. Ehrenberg[jj] has thrown out the conjecture that these little creatures were the agents employed in the miracle worked by Moses. Sheppard (*Transactions Micro. Soc.*, July, 1867) thinks these monads were the *Euglena Sanguinea.* "Ehrenberg discovered a new world of creatures in the infusoria, so minute that they are invisible to the naked eye. He found them in fog, rain, and snow, in the ocean, in stagnant water, in animal and vegetable juices, in volcanic ashes and pumice, in opal, in the minute dust that sometimes falls on the ocean; and he detected eighteen species twenty feet below the surface of the ground in peatbog, which was full of microscopic live animals. * * * * * While enquiring

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(j) The Mason-fly preys as much on spiders as spiders do on flies.

(jj) "Enplongeant si bas dans la vie, je croyais y rencontrer les *fatalités physiques,* et j'y trouve la justice, l'immortalité, l'espérance."—MICHELET, *l'insecte.*

into the causes of cholera, which prevailed at Berlin in 1848, Mr. Ehrenberg discovered 400 species of microscopic animalculæ in different strata of the atmosphere, so that the air is analogous in the distribution of its inhabitants to the ocean, which has marine animals peculiar to different depths. The lowest order of animal life is much more abundant than any other, *and new species are found every day.* * * * * Language and even imagination fail in the attempt to describe the inconceivable myriads of these invisible inhabitants of the ocean, the air, and the Earth."—*Somerville's Physical Geography*, p. 389.

Lardner (*Mus. Scient. et. Art*, vol. 6., pp. 2, 202) says: "The microscopic researches of Ehrenberg have disclosed most surprising examples of the minuteness of which organised matter is susceptible. He has shown that many species of infusoria exist which are so small *that millions of them collected into one mass would not exceed the bulk of a grain of sand,* and *a thousand might swim side by side through the eye of a needle.*"

"The size of many bears the same relation to that of a mite as the dimensions of a bee to those of an elephant." (*Encyclopèdia Britannica*, Art. "Animalcule"). And another authority remarks that some species are known to exist so small that a cubic inch would hold more in number than there are human beings upon the face of the Earth.

Highly-concentrated salt water appears of a red color; this color depends on the presence of myriads of monads, and the *Artemiæ* living on these partake of the same red hue, and thus certain waters appear of the same color. Ehrenberg says all true infusoria, even the smallest monads, are organised animal bodies; and even throughout the whole range of life, organisation is only reduced as life is reduced; in fact I may state it is a LAW in physiology that the vital phenomena become fewer and simpler as the various organs of the system diminish, and even the functions end as the respective organ disappears. This can be proved to be true in every department of Zoology.

Animals are as varied in form and magnitude as the imagination can conceive; from the God-like image of Man to the globule of jelly that floats on the wave; from the ancient Plesiosaurus and Iguanodon, Champions of the Oolitic and Cretaceous periods, Pythonomorphus, Dinotherium, and Zeuglodons Cetoides, to the insect and the animalculæ, of which millions may be obtained in a drop of water.

Captain Scoresby thinks that a tumbler of water from the Greenland seas will contain[k] one hundred and fifty millions of marine animalculæ.

Parkinson calculated that there are 26,000 separate elements in the skeleton of *encrimus moniliformis.*

Buckland found 150,000 elements in that of *pentacrinus briareus.*

Ehrenberg and others show twenty-six species of monads, of which the smallest never exceed $\frac{12}{1,000}$ of an inch in diameter. Usually, they measure $\frac{1}{15,000}$ to $\frac{1}{12,000}$ of a line in length.

The *monus crepusculus* measure only about $\frac{1}{32,000}$ of an inch in length.

Botanists have claimed them amongst Volvocinæ, Confervoid, Algæ; whilst Ehrenberg describes them as Infusoria.[1]

(k) The Apus, or Shield-shrimp, has "60 pairs of branchial feet, and other appendages no less than 1,802,604 joints" (Schæffer); but Jurine increases the numbers upwards of two millions.

A fertilised female of "Cyclops quadricornis" may have, in a single year, a progeny of 4,442 millions of young.

(l) In certain very inferior organisms, in certain protozoaries, digestion is as completely lacking as in the vegetable kingdom. In gregarine, e.g., the alimentary substances are absorbed in the state of solution, by all the points of the surface indifferently. Polytoma, difflugia, enchelys, monas, amæba which are monocellular infusoria formed of a single homogenous substance; some of these consist of a slowly concractile substance, which appears to be rudimentary fibre.

Dr. L. Tait found proof of a digestive process in "Cephalotus Nepenthes Dionæa," and the "Droseracæa," but failed in "Sarracenia," or Pitcher Plants, and "Darlingtonia." The

Naturalists consider the phosphoric light of the marine animalculæ to be the effect of vital action; the sparks are intermitting, like the fire-fly: they measure from $\frac{1}{12,000}$ to $\frac{1}{100}$ of an inch.

In the Photocaris, Ehrenberg found a cellular structure with large cells, and a gelatinous interior resembling the electric organs of the Gymnotus and Torpedo. It gives out light either at pleasure or when irritated or stimulated: the fire is an organic vital act. Infusoria kept by Ehrenberg, which has been obtained from the Baltic, gave sparkles of light. The smallest was $\frac{1}{48}$ to $\frac{1}{96}$ of a Paris line, which Paris line is $\frac{9}{100}$ of an English line.

The poet has beautifully expressed the minuteness of these animalculæ in the following words:—

"The shapely limb and lubricated joint
Within the small dimensions of a point;
Muscle and nerve, miraculously spun,—
His mighty work, who speaks, and it is done;
The invisible in things scarce seems revealed,
To whom an atom is an ample field."

And again—

"That those living things
To whom the fragile blade of grass,
That springeth in the morn
And perisheth ere noon,
Is an unbounded world.
That those viewless beings,
Whose mansion is the smallest particle
Of the impassive atmosphere,
Enjoy and live like man!
And the minutest throb
Which through their frames diffuses
The slightest, faintest, motion,
Is fixed and indispensable
As the majestic laws
That rule yon rolling orbs."

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glands of Nepenthes are similar to peptic follicles of the human stomach. When the process of digestion is conducted with albumen, the products are exactly the same as when pepsine is engaged: results give same re-actions with re-agents, especially violet characteristics, with oxide of copper and potash, and I think they are peptones.

Dr. Rolleston says—"There are organisms which at one period of their life exhibit an aggregate of phenomena such as to justify us in speaking of them as animals, whilst at another they appear to be as distinctly vegetable.[m]

"It is extremely difficult in individual cases," says Nicholson, "to come to any decision as to the kingdom to which a given organism should be referred, and in many cases the determination is purely arbitrary. But if we view the vegetable kingdom quantatively it is a kingdom of ternary carburetted substances, and the animal kingdom is carburetted substances azotised or quarternary."

It has been calculated that one drop of water contains 500 millions of these (infusoriæ) minims of creation. They have neither vessels, nerves,[n] nor distinct sexes; and no distinct eye has been found; they also appear to be without any digestive organs.

"A cubic inch of some infusions," says Ehrenberg, "would contain more organisms than there are people on the globe. A cubic line of the *polirschiefer* of Bilin con-

(m) De Mirbel, many years ago (1831-32), showed that the tissue of plants is composed of utricles and cells.

(n) The simplest form of a definite nervous system is presented in the "Aschidians," "Molluscs," and several species of Medusæ.—Vide "Observations of SCHAFER and O. and R. HERTURG. Proceed. Royal Soc., January, 1878.

Examine hemispherical Tiaropsis for movements.

Delicate impressions of sea-water, and some electrical action with the surface of the organism may cause movements. The animal may thus feel; and to feel, and not to know that they feel, is an impossibility.—Vide J. S. MILL, on "Exam. of Sir W. Hamilton's Philosophy," pp. 132.

Many insects have the organ of smell so fine as to distinguish emanations of matter (odor) inappreciable to the spectroscope.

It is impossible to find creatures endowed with motion and the organ of smell, and yet lacking a nervous system. The organ of smell originates from the olfactory nerve.

The phenomena of allotropism and dimorphism, and the fluxes from the crystalloid to the colloid state and the reverse, are strictly comparable with the transformations from the vegetal to the animal, and from the animal to the vegetal modes of growth so common amongst "ephemeromorphs."

tained, in round numbers, twenty-three millions of fossil skeletons; whilst a cubic inch of the same contained 3,974,400,000, and the weight of each fossil was 180 millionth of a grain.

A cubic inch of stone from the quarries of Gentilly contains nearly 60,000 of these fossil shells, and from 4 to 6,000 have been found in an ounce of sand in the Adriatic Sea; while in the West Indies as many as 3,840,000 have been found in the same quantity.

The *Rhizopoda* or *Foraminifera* are so numerous that the largest pyramids of Egypt and the houses of Paris may be said to be built of them. In Egypt the Nummulites, in Paris the Miliola. Leuwenhœck says that in the semen of a single fish there are thirty times as many animalculæ as there are human beings on the globe.

Dr. Mantell, in his Wonders of Geology, vol. II, pp. 670, says—"Probably there is not an atom of the solid materials of the globe which has not passed through the complex and wonderful laboratory of life."

ORIGIN OF LIFE.

Life itself is simply the result of chemical, electrical,[a] and mechanical forms of force, and death is a negative state of the same. Again, in other words, we may say life is the result of simple molecular exchange, comparable to those that take place in an electric pile; allow those molecular changes to fail, life is then a blank, and our corporeal parts become a mass of inert matter.

(a) Professor Tyndall says that there is sufficient electricity existing in a drop of water to sustain life: If so, an abstraction of the same amount would cause a cataclysm of life. If electricity is carried to a certain point, crystallisation would occur; and "to live and to crystallise," says Ch. Robin, "are two properties incompatible with organised creation, which are never united." Some writers, however, think that crystalloidal bodies may exist in colloidal bodies, and possibly they become vital when the form of the crystalloidal body changes.

All living beings have, in the first place, formed part of a body like their own, having been attached to a parent before the period of their independent existence. The new animal, while thus connected, is called a germ : its separation constitutes generation or birth. After this it increases in size according to certain fixed laws for each species and each part.

The duration of existence is limited in all animals : after a longer or shorter period the vital movements are arrested, and their cessation or death seems to occur as a necessary consequence of life.

" A lifeless object makes no appreciable response to external objects."—BASTIAN.

What can be said about persons in a trance, who have no motion or sensation ?—N.C.

Life is the " Principle of Individuation."—COLERIDGE.

Bichat says life is " the sum-total of the functions which resist death."

Dr. G. J. Allman, former Regius-Professor of Natural History in Edinburgh, took ground that the physical basis is not also the psychical or spiritual basis of life, and criticised Huxley in friendly frankness. A few sentences of his address will show the tendency of its thought :—

" When, however, we say that life is a property of protoplasm, we assert as much as we are justified in doing. Here we stand upon the boundary between life in its proper conception, as a group of phenomena having irritability as their common bond, and that other and higher group of phenomena which we designate as consciousness or thought, and which, however intimately connected with those of life, are yet essentially distinct from them. . . . . . When a thought passes through the mind it is associated, as we now have abundant reason for believing, with some change in the protoplasm of the cerebral cells. Are we, therefore, justified in regarding thought as a property of the protoplasm of these cells, in the sense in which we regard muscular contraction as a property of the protoplasm of muscle ? Or is it really a property residing in something far different, but which may yet need for its manifestation the activity of cerebral protoplasm. . . . . . The chasm between unconscious life and thought is deep and impassable, and no transitional phenomena can be found by which as by a bridge we may span it over. . . That consciousness is never manifested except in the presence of cerebral matter, or of something like it, there cannot be a question ; BUT THIS IS A VERY DIFFERENT THING FROM ITS BEING A PROPERTY OF SUCH MATTER in the sense in which polarity is a property of the magnet, or irritability of protoplasm. . . .

Whatever may be that mysterious bond which connects organisations with psychical endowments, the one grand fact—a fact of inestimable importance — stands out clear and free from all obscurity and doubt, that from the first dawn of intelligence there is in every advance of organisation a corresponding advance in mind. Mind as well as body is thus travelling onward through the destiny of our race; and though now we may at most but indicate some weak point in the generalisation which would refer consciousness as well as life to a common material source, who can say that in the far-off future there may not yet be evolved other and higher faculties from which light may stream in upon the darkness, and reveal to man the great mystery of thought ?"

A difficulty appears to us to occur when the process of dividing into molecules occurred, or the cause or impressment of running into organic form. If materialism and science are dumb and confounded, to whom is it revealed ? Let priest and philosopher one and all acknowledge their ignorance.—N.C.

Gassendi, the great ecclesiastic, writes as follows on Creation :—

"God, who created earth and water, plants and animals, produced in the first place a definite number of atoms, which constituted the seed of all things. Then began that series of combinations and decompositions which goes on at present, and which will continue in future. The principle of every change resides in matter.

Lucretius the Roman (born 99 B.C.) refutes the notion that any thing can come out of nothing, or that which is once begotten can be recalled to nothing. The first beginnings, the atoms, are indestructible, and into them all things can be resolved at last. Bodies are partly atoms, and partly combinations of atoms ; but the atoms nothing can quench. They are strong in solid singleness, and by their denser combination all things can be closely packed and exhibit enduring strength. He denies that matter is infinitely divisible. We come at length to the atoms, without which, as an imperishable substratum, all order in the generation and development of things would be destroyed.

The mechanical shock of the atoms being in his view the all-sufficient cause of things, he combats the notion that the constitution of nature has been in any way determined by intelligent design. The interaction of the atoms throughout indefinite time rendered all manner of combinations possible. Of these the fit ones persisted, while the unfit ones disappeared.

The first living beings spontaneously organised themselves[b] at the expense of mineral matter. The first inhabitants were very simple—the monera of Hæckel, some types of infusoria, the rhizapods, perhaps, which recall, us to the primitive ancestors of the world. And these simple or primitive ancestors or organisms, which are purely organised matter, are " like rifle bullets fired straight at a mark." Darwin compares them to grape-shot, of which one hits something, and the rest fall wide.

Schwann viewed the origin of matter as having inherent properties implanted in it from its very creation, for he says—" The cell when once formed continues to grow by its own individual powers." The organic cell is the corner-stone of the living world—the common mother of all histological elements. Maunsell asserts that every atom of dust beneath our feet has once been the source of life. Even the oyster shell, though inanimate, is not inorganic.

PROTOPLASMIC LIFE.

Protoplasm consists of C,H,N,O : these are lifeless bodies, but under certain conditions, form protoplasm, and this protoplasm exhibits the phenomena of life. Heat, light, and moisture may be the principal mysterious ism which originates life, when exposed to atmospheric influence, or when the substance is exposed to the electro-magnetism emanating from the Sun, and passing through both poles to the Earth.

(b) It is easy to suppose motion induces life, or vice versa, life induces motion. The moulding of organic matter into the simplest types must have commenced with portions of protoplasm, more minute, more indefinite, and more inconstant in their characters than the lowest Rhizopods, less distinguishable from mere fragments of albumen than even the protogenes of Professor Hæckel.

It might be said that nutrition is the object of life, if life has an object, but it has none, since it is simply the result of a fortuitous concurrence of cosmical geological climateric and even orological facts. It has not always existed on our little planet. It will be extinguished there one day.

Dr. Louis Buchner, of Hessen-Darmstadt, one of the first physiologists of Germany, thinks life originated spontaneously by the combination of molecules of matter under favorable circumstances, and that everything is due to matter and its forces, whether inorganic, organic, physical, vital, or mental. It is no doubt a law of Nature that inorganic matter in certain conditions, and under the influence of certain combined and yet unknown forces —forces, however, not unknown to Nature, but entirely as yet hidden from our ken, will assume an organic form. The grand cause of the production, development, and duration of organised beings, or matter, is solar irradiation. It is fixed, accumulates in the plant, serves as animal alimentation; this irradiation is treasured up by it, transforms itself into various series of molecular vibrations, into heat, movement, thought, &c. The caloric undulations are not less indispensable to the nutrition of plants: for above and below a certain temperature vegetal life ceases.

New and changed conditions, whether caused by irradiation or artificial means, "certainly play an important part in exciting organic changes of all kinds." (Darwin's Descent, vol. II, p.p. 388).

BATHYBIUS.

Bioplasm, otherwise called Protoplasm by many, executes so many movements that the same mass probably never twice in its life assumes the same form; it acts probably by catalysis when in contact with suitable bodies. Huxley says "we fail to detect any organisation in the bioplasmic mass."

Dr. Drysdale (on "Protoplasmic Theory of Life")[c] says that *bioplasm* is a form of matter *sui generis*; and

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(c) "Ciliated Infusoria, Rotifers, and other forms of animal life of different degrees of complexity, may take origin in encysted masses of protoplasm, forming the resting-stages of previously active Amebæ."—Bastian.

that its activity is an outcome of transmuted physical force, or the result of irritability under stimulation.* However, in conclusion, I may say unhesitatingly that "there are more things in Heaven and Earth than are dreamed of in our philosophy," and that if man should ever penetrate the "arcana" which enshrouds the origin of organic force, "it will be most probably by experiment and observation on the atoms" "that manifest the simplest conditions of life."—(OWEN).

Animals, such as the little sarcodic, gelatinous, contractile organisms, are called by Huxley *Bathybius Hœchelii.* Amongst these bathybians live foraminifers, rhizopods, radiolites, &c.

BIOPLASM.

On account of the scientific reports of the Challenger, Professor Huxley recanted too prematurely his earlier views on Bathybius.

In *Nature* (August 19, 1875), and in the *Quarterly Journal of Microscopic Science* (1875, vol. xv., p. 392), he writes as follows:

"Prof. Wyville Thomson informs me that the best efforts of the Challenger staff have failed to discover Bathybius in a fresh state, and that it is seriously suspected that the thing to which I gave that name is little more than sulphate of lime, precipitated in a flocculent state from sea-water by the strong alcohol in which the specimens of the deep-sea soundings which I examined were preserved. The strange thing is, that this inorganic precipitate is *scarcely to be distinguished from precipitated albumen,* and it resembles, perhaps, even more closely, the poligerous pellicle on the surface of a putrescent infusion (except in the absence of all moving particles), ordering irregularly, but very fully, with carmine, running into patches with defined edges, and in every way comporting itself like an organic thing. *Prof. Thomson speaks very guardedly, and does not consider the fate of* Bathybius *to be*

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* CIONA INTESTINA, squids, and cuttle-fish,—even eggs of trout and frogs,—are stimulated in development by violet and blue light, and retarded by red and green. When comparing M. Serrano-Fatigati and Young's experiments with Infusoria, there is one general character for aquatic animals, but we have yet to discover whether terrestrial ones are influenced in the same way.

as yet absolutely decided. But since I am mainly responsible for the mistake, if it be one, of introducing this singular substance into the list of living things, I think I shall err on the right side in attaching even greater weight than he does to the view which he suggests."

"These words of Prof. Huxley's," said Prof. Hæckel, "awakened marked interest, and were pretty generally thought to be the death-blow of poor Bathybius. But, in proportion as the real parents of Bathybius show a disposition to abandon their child as being beyond hope, the more do I consider it to be my duty as its godfather to defend its rights and, if possible, to restore its expiring vital spark. Here, as luck would have it, I find a valuable ally in the person of a traveled German naturalist, who quite recently observed living Bathybius off the coast of Greenland.*

Professor Hæckel continues, thus : "Bathybius, about which so much has been said, has no existence; the assumption of its existing rested on illusions. It will be the same with the rest of the Moneres; these supposed primordial organisms, too, will prove to be the product of erroneous observation. So has one of the main supports of the modern development doctrine fallen, and it will yet be found that all its other supports rest upon illusions and errors. The whole fabric of Darwinism is simply an air-castle, the theory of natural selection is a soap-bubble, and the doctrine of descent is not true.

Such is the gist of many an article published during the past year in all sorts of periodicals. Simply and solely from the supposed non-existence of Bathybius it is rashly inferred that there is no such thing at all as Moneres, and that the doctrine of evolution is badly hit. This assertion is of course made with most gusto by the opponents of the development theory. The clergy are already rejoicing over the utter downfall of the theory of descent. But even among the adherents of the theory of evolution, the non-existence of Bathybius is held to be proved, and from this fact a series of conclusions is drawn which suggests more or less weighty objections against some of the main principles of Darwinism. These circumstances, as also the confusion of the public mind as to the actual state of the

case, have induced me to consider the Moneres question with special reference to Bathybius. It would appear to be specially my right, nay, even my duty, to discuss this question, inasmuch as it was my dubious luck to have stood godfather to this ill-famed primordial slime of the sea-depths.

Huxley gave to it in baptism the name *Bathybius Hæckelli.* He of course could not have foreseen that the poor neophyte would, like another Icarus, in a very short time become a biological celebrity, ascending to the heaven of terrestrial fame, and then before the end of its first decennium tumbling down into the gloomy Hades of mythology. Let us see, then, whether it is really dead, and whether it has ever existed at all. And supposing we have to admit its merely mythological apparition-existence, let us see what consequences result for the Moneres.

I. *History of the Moneres.*—In the spring of 1864 I observed in the Mediterranean, at Villafranca, near Nice, little floating globules of slime, one millimetre or half a line in diameter, which interested me very much. Under the microscope each of these globules looked like a little star, its centre consisting of a far smaller, structureless globule, while from the outer surface radiated several thousand exceedingly fine threads. Close examination with high powers showed that the whole body of the star-shaped thing consisted of simple albuminous cell-substance—*sarcode*, or *protoplasm ;* and that the threads radiating on all sides from the surface were not permanent organs, but constantly variable, in number, size, and shape. They were seen to be changing and non-persistent processes of the central protoplasmic body, like the "false feet," or pseudopodia, which constitute the only organs of the Rhizopods. But while in the Rhizopods cell-nuclei are scattered through the protoplasm, and their bodies, morphologically considered, are made up of one or of many cells, nothing of the kind is to be seen in the protoplasmic globules observed at Villafranca. For the rest, no difference was to be found between the two with respect either to the motions of the filaments or to the manner in which they were employed as organs of touch for sensation, or as

organs of nutrition for taking in food. To complete the natural history of the little protoplasm-globule, which I had studied with great minuteness, all that was still needed was a knowledge of its mode of propagation. In this, too, I was finally successful. After some time the little creature broke up into two halves by simple division, and each of these went on living like the original one. Thus I had learned the whole life-cycle of what I had to regard as one of the simplest organisms conceivable, and I gave it in recognition of its fundamental significance, the name of *Protogenes primordialis*, "first born of primeval time." An accurate description of it was published by me in vol. xv. of the *Zeitschrift für wissenschaftliche Zoologie* (p. 360, Plate XXVI., Figs. 1 and 2).

The very next year, two distinct extremely simple organisms, very closely resembling Protogenes, were described by the distinguished microscopist Cienkowski. In vol. i. of the *Archiv für mikroskopische Zoologie* (p. 203, Plates XII.–XIV.) he published very interesting "Contributions to the Knowledge of Monads." Among the various Protista here associated by Cienkowski under the old, ambiguous term "Monads" occur two microscopic inhabitants of fresh water, which in the perfectly simple and structureless constitution of their unnucleated form, radiate protoplasmic body resemble Protogenes—the general Protomonas (*Monas amyli*) and Vampyrella (the latter in three different species); they differ, however, from Protogenes in their mode of propagation. Whereas Protogenes, after it has grown to a certain size, does not gain any further increase of mass, but directly breaks up into two fragments, Protomonas and Vampyrella retract their rays, and pass into the inactive state, and meanwhile the little protoplasmic globule becomes encysted, or surrounded with an envelope (cyst). While so encysted, Protomonas breaks up into a great number of smaller globules, and Vampyrella into four fragments (tetraspores). All of these afterward become free, and by simple process of growth are developed into the perfect form.

In the meantime I had myself observed, in fresh water at Jena, a fourth allied genus of extremely simple organ-

isms, in all respects like the common Amœba, but distinguished from it by having no cell-nucleus, and no contractile vesicular envelope; hence I named it *Protamœba primitiva.* While in the first-named three slime-globules (Protogenes, Protomonas, and Vampyrella) numerous filaments radiate from the entire surface of the central protoplasmic body, in Protamœba, on the contrary, just as in the common Amœba, there are only a few short, finger-shaped processes, which are constantly changing, being now retracted, and again pushed out in some other place. When Protamœba has, by taking in food—which operation it performs after the manner of Amœba—attained a certain size, it breaks up by division into two parts. I published my observations of Protamœba in the "Generelle Morphologie," vol. i., p. 133. Afterward I published figures of *Protamœba primitiva*, which are to be found in my "Natural History of Creation," sixth German edition, p. 167, and in my "Anthropogenie, third edition, p. 414.

Backed by these observations, which were still further prosecuted afterward by other investigators, and also by myself, I, in 1866, in the "Generelle Morphologie," established a special class, that of Moneres (i.e., *simple*), for all these organisms of most simple constitution. In the first volume of that work I wrote as follows:—

"In order clearly to distinguish from all other organisms made up of heterogeneous parts these simplest and most imperfect of all organisms, wherein neither the microscope nor chemical reagents can detect any differentiation of the homogeneous plasmic body, we give them, once for all, the name of *Moneres*, or simple organisms. Surely, if we would explain life; if we would deduce it from falsely so-called 'dead matter;' if we would fill up the chasm between organisms and the inorganic world—we must needs give special attention to these very interesting but hitherto quite neglected organisms, and lay the greatest stress upon their exceedingly simple morphological constitution, which nevertheless is entirely consistent with the discharge of all the essential functions of life. Inasmuch as in these homogeneous living things no trace is to be discovered of different morphological constituents, of 'organs;' but, on the contrary, as all the molecules of the structureless carbon compound of the living albumen of which they consist are equally capable of performing the various life-functions, it is plain that the idea of an organism

can be educed only dynamically or physiologically from vital movement, and not statically or morphologically from the composition of the body out of 'organs.'"

For some years after this the circle of our experiences with these strange "organisms without organs" was considerably widened. During my voyage to the Canary Islands in 1866–'67 I very naturally directed my whole attention to the organisms, and was so fortunate as to discover many new forms of Moneres. On the white calcareous shells of a remarkable Cephalopod (*Spirula Peronii*), found in thousands on the coasts of the Canaries, I have sometimes noticed numerous little red points, which under the magnifying-glass looked like ornamental stars, and, when highly magnified, like orange-red photoplasmic disks or globules, from the circumference of which radiated numerous three-shaped filaments, with branches. Closer observation showed that these (comparatively colossal) protoplasmic bodies, too, were unnucleated and structureless, and that they propagated after the same manner as Protomonas, the globular, encysted body breaking up into a great number of little fragments, To this new genus of Moneres I gave the name of *Protomyxa aurantiaca*, and it is figured in Plate I. of the "Natural History of Creation." I then, during the same year (1867), found a like magnificent Moneres form in the mud of the harbor of Puerto del Arrecife, the port-town of the island of Lanzarote, and to it gave the name of *Myxastrum radians*. Its distinguishing mark is this, that the fragments of spores into which the globular body breaks up in the act of propagation arrange themselves in lines radiating from the centre of the globule, and exude spindle-shaped, siliceous envelopes, from which the young Moneres afterward drops out.

On the strength of all these observations, I, in 1868, published in the *Jenaische Zeitschrift für Naturwissenschaft* an extended "Monograph of the Moneres" (vol. iv., p. 64, Plates II. and III.). In this monograph both my own observations and those of others are set forth at length and discussed. At that time the number of known genera of Moneres was seven. By later observations it has been increased to sixteen, as is stated by me in my "Supplement

to the Monograph of the Moneres" (*Jenaische Zeitschrift für Naturwissenschaft*, 1877, vol. vi., p. 23). The differences between these Moneres come simply from the fact that the soft, slimy mass expands and moves in different forms, and that the asexual propagation (by division, sporeformation, etc.) takes place in different ways.

II. *History of Bathybius.*—The great interest possessed by the Moneres morphologically as well as physiologically was further heightened when, in 1868, the foremost zoölogist of England, stated that it was probable the observations of Wyville Thomson Carpenter and Bessels on the movements of living Bathybius were correct. We will, however, for the nonce, suppose the contrary to be the fact, and will grant that Bathybius is not a Moneres or even an organism. Does it follow from this that the Moneres too have no existence? Or must we say that, as the familiar great sea-serpent of fable does not exist, therefore there is no such thing as a sea-serpent? We know that there are many sea-serpents belonging to the family of the viviparous and highly-venomous *Hydrophidæ (Hydrophis, Platurus, Æpysurus*, etc.), which chiefly inhabits the Indian Ocean, and the Sunda Archipelago, but none of which attain any considerable size.

It were useless here again to quote my own researches which have demonstrated the existence of upward of a dozen different species of Moneres, some living in fresh, others in salt water. I would, however, state that these observations have since been repeated and confirmed by a number of competent investigators. Some of these Moneres appear to be very widely distributed in fresh water, as for instance the genera Protamœba and Vampyrella. *Protamœba agilis* and *Vampyrella spirogyræ* may be observed almost any summer at Jena *P. primitiva* and *V. vorax* have been seen by sundry observers in very diverse localities. Other new Moneres forms have been quite recently discovered by Cienkowski and Oskar Grimm. When the attention of microscopists has been more generally directed to these extremely simple organisms, we may hope that our knowledge of them will be considerably widened and deepened.

Whether Bathybius is or is not a true Moneres, at all events we already know with certitude a number of *true Moneres* whose fundamental importance is quite independent of Bathybius. We know that even now there exist in the waters of our planet a number of very low forms of life, which are not only the simplest of all actually observed organisms, but even the *simplest imaginable* of living things. Their whole body, in the fully-developed and reproductive condition, consists of nothing but a little mass of structureless protoplasm, whose changing, variable processes all at once discharge the various life-functions—movement, sensation, transmutation of matter, nutrition, growth, and reproduction. Morphologically considered, the body of a Moneres is as simple as an inorganic crystal. We cannot distinguish in it separate parts; or, rather, each part is equivalent to each other. These facts and their far-reaching consequences apply to *all Moneres* without exception—with or without Bathybius!—and hence it does not affect the theory at all whether Bathybius exists or not.

When we describe these Moneres as "absolutely simple organisms," we of course only express their *morphological simplicity*, the absence of distinct organs. Chemico-physically, they may be highly composite; indeed, we must in any case ascribe to them, as to all albuminous bodies, *a highly-complex molecular structure.* Many regard the slime-like albuminous body of Moneres as a single chemical albumen combination, while others see in it a multitude of such combinations; others, again, regard it as an emulsion or intimate blending of albuminous and fatty particles. For a general biological view of the Moneres this is of subordinate interest; for, however the case may be, the creature is at all events, *from the anatomical point of view*, perfectly simple—an organism without organs. It proves incontrovertibly that life does not depend on the coöperation of different organs, but on a certain chemico-physical constitution of amorphous matter—on that albuminous substance which we call sarcode or protoplasm—a nitrocarbon compound in the semi-fluid state.

Hence, life is not a result of organisation, but *vice*

versa.—Amorphous protoplasm gives rise to organised forms.—Having already, in previous writings, called attention to the high importance of the Moneres from this and other points of view, I can here only refer to those papers. At present I must content myself with pointing out the importance of the Moneres in connection with the great question of the origin of life. The oldest organisms, sprung by spontaneous generation (Urzeugung) from inorganic matter, must have been Moneres.

It is precisely the general importance of the Moneres for the solution of the greatest of biological problems that makes them a stumbling-block and a scandal to the opponents of the doctrine of evolution. These men, of course, take every opportunity to dispute the existence of Moneres, exactly as was done in the case of *Eozoön Canadense*, the much-disputed oldest fossil of the Laurentian formation. The most experienced and competent students of the class Rhizopoda—at their head Prof. Carpenter, of London, and the distinguished anatomist Max Schultze, of Bonn, deceased—are firmly convinced that the American Eozoön is a genuine Rhizopod—? Polythalamium, near akin to Polytrema, I have myself for several years made a special study of Rhizopods. I have minutely examined several fine preparations of Eozoön made by Carpenter and Schultze, and I have not the slightest doubt that it is a genuine Polythalamium, and not a mineral.

But, just because of the extraordinary fundamental importance of Eozoön, and because the discovery of that fossil adds several millions of years to the earth's organic history, making the primitive Silurian formations to appear recent by comparison, and rendering a great service to the doctrine of evolution, therefore it is that the opponents of that doctrine so stoutly affirm that it is not of organic origin at all, but purely mineral. But as the high importance of Eozoön was placed in its proper light by these unavailing attacks of ill-formed opponents, so is it, too, with the Moneres—with or without Bathybius. The true Moneres remain, forming an immovable foundation-stone of the doctrine of evolution."—Prof. Ernest Hæckel.)

PROTOPLASM.

"Bathybius," says Professor L. Beale, in his work on "Protoplasm" (London, 1874, p.p. 110, 368, 371), "instead of being a widely-extending sheet of living protoplasm, which grows at the expense of inorganic elements, is rather to be regarded as a complex mass of slime with many foreign bodies and the *debris* of living organs which have passed away mixed in it. Numerous minute living forms are, however, still found upon it."

Huxley says: "A mass of living protoplasm[e] is simply a molecular machine of great complexity, the total results of the working of which, or its vital phenomena, depend, on the one hand, on its construction, and on the other, upon the energy applied to it; and to speak of 'vitality' as anything but the name of a series of operations is as if one should talk of the horologity of a clock."

Tyndall, when delivering his Belfast lecture, spoke as follows on simple organisms:—"We come at length to simple organisms which I have compared to drops of oil suspended in a mixture of alcohol and water. We reach the *protogenes* of Hæckel, in which we have 'a type distinguishable from a fragment of albumen only by its finely granular character.' Can we pause here? We break a magnet and find two poles in each of its fragments. We continue the process of breaking, but, however small the parts each carries with it, though enfeebled, the polarity of the whole. And when we can break no longer, we prolong the intellectual vision to the polar molecules. Are we not urged to do *something* similar in the case of life? Is there not a temptation to close to some extent with Lucretius, when he affirms that 'Nature is seen to do all things spontaneously of herself without the meddling of

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(e) Independent living forms may present but little advance from an individual mass of protoplasm.—N.C.

"All the higher forms of life are aggregates of such morphological units or cells, variously modified."—Huxley, Prof Encyc. Brit., 9th Edit., Biology, pp. 681, 682.

the gods?' or with Bruno, when he declares that Matter is not 'that mere empty capacity which philosophers have pictured her to be, but the universal mother who brings forth all things as the fruit of her own womb?' Believing as I do in the continuity of Nature, I cannot stop abruptly where our microscopes cease to be of use. Here the vision of the mind authoritatively supplements the vision of the eye. By an intellectual necessity I cross the boundary of the experimental evidence, and discern in that matter which we, in our ignorance of its latent powers, and notwithstanding our professed reverence for its Creator, have hitherto covered with opprobrium, the promise and potency of all terrestial Life.

If you ask me whether there exists the least evidence to prove that any form of life can be developed out of matter, without demonstrable antecedent life, my reply is that evidence considered perfectly conclusive by many has been adduced."

Huxley thinks that if we trace back the animal and vegetable world, we will find preceding what now exists, animals and plants not identical with them, but like them, only increasing their differences as we go back in time, and become still simpler until we arrive at the gelatinous mass, which, so far as our present knowledge goes, is the foundation of life, and perhaps if traced further back will bring us to the general nebulous condition of matter.

COLLOIDAL BODIES.

Every organised being is a compound of colloidal bodies holding in solution crystalloidal bodies. But these organised bodies are in a perpetual renovation. Unceasingly the colloidal body plays face to face with the external medium, the part of dialyser, either directly or by the aid of a special apparatus. It forms nutritive soluble substances, and rejects waste substances, likewise soluble, at least in the liquids of the organism. Finally the colloidal state is the form the most suitable for the manifestations of the instability, the molecular mobility of the complex

bodies which constitute organised beings. Under this form they are really in the dynamical state; without difficulty they yield to the shock, to the action of incident bodies. They can make and unmake themselves, become the scene of perpetual exchange of molecules and of atoms, in fact, of a vital progression and regression.

It is really wonderful that certain bodies such as (HO) = Water × Albumen × Fat and Phosphate salts by atomic synthetical combination, or the peculiar position or atomic antagonism they hold to each other, can evolve thought, will, and action, for if they are not evolved from the molecular changes of the brain, why is *Intellect* absent when a small blood vessel bursts and presses on the brain; in fine, if the current of blood is stopped, the mind is dethroned, and memory gone. If, again, the combination of the above-mentioned bodies evolve thought, desire, &c., I ask will the same salts produce animal life, if not, how are matter's various forms developed?

Since all the organisations now or in past time on the Earth were potentially in the primordial germ, so that germ was potentially in the unorganised particles of the star-dust, or, in other words, there was latent in matter from the first the power to evolve organisation, thought, emotion, will, &c. It will be no Christian profanity to say, as Charles Kingsley expresses himself, that no harm can happen "to religion, even if it be demonstrated, not only that God is so wise that He can make all things, but that He is much wiser than even that,—He can make all things make themselves? And if, again, God can lift the visible (silkworm) out of the chrysalid, may he not be able to lift the [f] invisible thought also." Kant astutely said, in speaking on the formation of inorganic bodies, "give me matter, and I will explain the formation of a world."

(f) The nearer we get to the controlling forces of Nature, the farther we get away from the palpable and solid. It is unceasingly urged upon us by Nature that the unseen world is a world of causes, of primary forces, of permanent powers. All the most powerful and universal forces are now referred to minute vibrations of an almost infinitely attenuated form of matter. Force, motion, and matter are indestructible, and must be blended together, if not so gravitation would be powerless.

ETHERIC MATTER.

As there is a point where it is still undecided when animal life terminates and vegetable life commences, or when inanimate becomes animate, so there will also be a point where visible matter terminates and etherial matter or ether-film holds sway. The odor of roses, camphor, and blood are felt, and known to be present, yet who can by the finest dialytical or spectroscopic instrument declare they can distinguish the emanations or fine particles passing off from those visible material bodies.

[g] Etheric matter no doubt has thousands of properties both active and passive. One of its active or positive states appears as *light*, another form appears as a negative or nascent state, which is called darkness, and as its atoms present their concave or convex surfaces, so will different properties be evolved, whether of light or darkness.

Life [h] itself possibly commenced with atomic matter, simply unorganised, and terminates in most complex compound etherial bodies so attenuated or refined, that no gross material body can appreciate, much less conceive,

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(g) If ether is liquid matter, it can never be in a state of rest, as Nature abhors rest as much as she does a vacuum. Even the rays of light can only be conveyed through the vibration of ether atoms.

Dr. E. D. Babbitt, of New York, in his book on "The Principles of Light and Color," tells of grades of ether finer and finer, and of vibrations producing colors far finer than those of our visible spectrum.

(h) Sir W. Thomson thought light may have been inducted into this planet from life in some exterior physical source.

It will be observed that the rate of nervous transmission is comparatively slow. Electricity travels at the rate of many thousand miles a second, or, more accurately, 16,000,000 times as fast as nervous action. Light moves about two-thirds as fast as electricity. If we examine movements, which are comparatively sluggish, we find that a cannon-ball, when fired, moves about 900 feet a second, or nearly ten times as fast as nervous energy. A railroad train speeding along at sixty miles an hour would be moving at about the same rate as an ordinary nervous stimulus, though in a contest the stimulus would probably win.

such an existence, and possibly no microscope or other philosophical appliance will for many ages, perhaps, if ever, discover their [i] properties. One species of matter can never elucidate or philosophise on another form of matter which so far transcends it as light does [ii] darkness.

"The brain (which is matter) secretes thought, as the liver does bile."—(Carl Vogt.) Atkinson asks, "what are the instincts of animals, and the mind of man, but a result of chemical action and material processes." Büchner says, "Matter is the origin of all that exists: all natural and mental forces inhere in it." Owen wrote in the Symposium thus: "In the interest of scientific clearness I object to say I have a soul, when I mean all the while that my organism has certain mental functions, which, like the rest, are dependent on its molecular composition, and come to an end when I die; and I object still more to affirm that I look to a future life, when all I mean is, that the influence of my doings and sayings will be regulated by anatomical brain [†] changes and results from external forces and environments."

(i) "The unity of physical forces is the point on which Science has its eyes now fixed."

"Heat, Electricity, light, magnetism, 'chemical attraction,' muscular energy, and mechanical work are exhibitions of one and the same power acting through matter."

(ii) "Who can tell all the windings, turnings, depths, hollowness, and dark corners of the mind of man. He who enters upon this scrutiny enters into a labyrinth or a wilderness, where he has no guide but chance or industry to direct his enquiries, or to put an end to his search. It is a wilderness in which a man may wander more than forty years, and through which few have passed to the promised land."—Dr. South.

"Our remedies of in ourselves do lie
Which we ascribe to Heaven."—(Shaksp.—"All's Well.")

(†) "It is no less certain that the muscles of a horse are strained by a heavy load than it is that the brain of Shakespeare undergoes molecular agitation, producing definite chemical results in the sublime effort of imagination."

If the soul [jj] exists (some deny its existence), it as an occupant of this etherial enswarthment, operates in part unconsciously, and in part consciously.[k] It then would co-operate with the vital force. It has then a different type for each different organism. As it were folded up, it exists of course in the embryonic germ of each organism—oak, lion, eagle, or man. It is the morphological agent which weaves all living tissue, not only of man but even that of rabbit, mouse, bug, gnat, and cabbage—if the germ comes into the parent from without, it can only be through the air or food eaten. Ferrier says that the brain is the organ of the mind, and that mental operations are possible only in and through the brain, and that we may, without further question, start from this an ultimate fact. When it rises to the state of consciousness, it produces the phenomena known as thought, imagination, emotion, and will. If we divorce life from matter, where then is life?

Every meal we eat, and every cup we drink, illustrates the mysterious control of mind by matter.

Now if thought is considered to be formed by heat or electricity acting on the brain as a ferment, molecular or atomic changes must occur, and if chemical change occurs,

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(jj) Pope Leo Decimus caused the question of the "immortality of the soul" to be argued pro and con, and concluded thus with the verse of Cornelius Gallus, "Et redit in nihilum, guod fuit ante nihil." "It began of nothing, and in nothing it ends."

"If you have not yet recognised your relationship to the souls ot the living, how can you discover your relationship to the spirits of the departed."—Confucius.

(k) "Consciousness of thought is distinct from the thought." —Prof. Bain.

"All physical phenomena have one and the same primordial agent as their original generator."

"'Chemistry, by its theory of equivalents, is tending to unity.' Few intelligent chemists now regard the elements ranked as simple as being simple any further than the present imperfection of our instruments compels us to class them as such."

"The substance of things evades all chemical testing; and so the simple bodies of chemistry are themselves only forms, more or less elementary, the agglomeration of which produces compounds."

heat will be evolved, and at the same time a moisture or subtle principle, essence or spirit will be exhaled, which may act, as many think, [1] sympathetically on another person; or by impressment of matter on matter. If it is asserted that this action is impossible on account of the skull or bone being a non-conductor of electricity and also preventing the passage of the subtle fluid, I reply that it has never yet been proved that brain matter cannot act on brain matter the same as the magnet does on iron. Before, however, we can fulminate a theory on this subject, our knowledge must greatly progress: we have not yet reached even the second stage of intellectual power, for our philosophy lacks perfection. It has only reached a point where the perceivable begins and the unperceivable strikes in, and *vice versa* where the imperceptible strikes it and brings out the perceptible.

Perception exists apart from matter and motion; for perception can conceive of what existed before it came

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"If by the theory of equivalents these forms should be some day reduced to unity, 'chemistry will be entitled to infer,' with some reason, the substantial unity of the Universe."

"To reduce all this multiplicity of things to a single principle has been, and continues to be, the ever-recurring problem. In physical science, in astronomy, in 'chemistry,' in physiology and psychology, the tendency now is toward unity. As we draw nearer to a principle of unity we draw nearer to a conception of God."—(Bornouf).

According to Leibnitz (and there are few greater names than his in philosophy) all substance is essentially a force. Active force is everywhere; it is the true principle of all corporeal phenomena; it is in the plant, in the animal, in the man, in the angel; it is in the Earth and in the highest heavens; it is the fundamental life of all beings. And what is this force but an efflux from the central energy to which the Universe owes its existence and its continuance from minute to minute.

"Things compound," says Swedenborg, "derive their origin from things simple; things simple from the Infinite; and the Infinite from itself, as being the sole cause of itself and of all things."

(1) The sympathy we express for a locality, flowers, or running streams is the sympathy of a human sympathetic soul. They once formed part of our system. There was a time when flowers and streams possessed the human race.—N.C.

into existence, from conception derived from present experiences.

[m] Existence itself, whether visible or invisible, comprises heat, light, electricity, magnetism, and gravitation, &c.,—for they are perceivable.

(m) Certain insects have the power of emitting light, such as the glow-worm, possibly to guide its mate.

But the most curious light-giving forms discovered are the fishes. Among the bony fishes of great depths, the families Scopelids, Sternoptychids, and Stomiatids, have long attracted attention, on account of the rows of bright spots that occur upon their sides, now found to be luminous.

These are found especially upon the fishes *Chauliodus Sloani*, *Stomias boa*, *Scopelus Humboldti*, &c. In the *Ichthyococcus ornatus* and *Scopelus rafinesquii*, they are specially abundant. In one species of the former, a large luminous spot occurs upon the front of the head.

The distinguished naturalist of the Challenger expedition, Willemoes-Suhm, now deceased, saw Scopelus fish phosphorescent in the night, of which he says: " One of them hung in the net like a shining star as it came out of the darkness. Possibly the seat of the light is in the peculiar side organs, and it may be that this phosphorescence is the only source of light in the great depths of the sea."

The thought that in the dark abysses of the deep sea every animal carries its lantern as the miner carries his lamp on his head, is a very fascinating one; and, indeed, Herr Willemoes-Suhm observed several other fishes that were provided on the smooth head and on the head-beard with a "remarkably large sense organ." Valenciennes has also remarked of the genus *Hemiramphus* that it bears a strongly glittering phosphorescent pustule on the tip of its tail.

Among the fishes discovered by the Challenger expedition was the *Echiotoma microdon*, a dark fish from two miles beneath the surface. Below its eyes were two luminous spots; a narrow elongated one above the maxillary, and a small, short organ nearer the eye.

Another species, the *Micripnus*, had long fringed barbels; luminous spots above the maxillary, small and round. This was found on the Australian coast in 2,150 fathoms.

A stomatoid fish, Bathyophis, found over three miles below the surface, had long barbels; small luminous organs above the middle of the upper jaw, and a number of others along each side of the abdomen; also on the tail and outer ventral rays.

In the Ipnops the body was long, covered with cylindrical scales, and devoid of luminous organs. The head was depressed,

FORMATION OF ORGANISED BODIES.

For most of the tissues the primary form is a germ or cell, for some few a fibre; some of the very lowest of organic beings, both in the vegetable and animal world, never proceed beyond this primary form, consisting of nothing more than a simple cell, as seen in the *Protococcus nivalis*, or red snow and monads.

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long, and spatulate, its entire upper surface occupied by a remarkable phosphorescent organ that was longitudinally divided into two symmetrical halves.

The most remarkable light-giving fish, however, is a shark, a species of *Scymnus*, and allied to our morse of the southern coast, discovered by Dr. Bennett in Australian waters. The light in this case was universal. In relation to this find, Dr. Bennett says:—" When the larger specimen, taken at night, was removed into a dark apartment, it afforded a very extraordinary spectacle. The entire inferior surface of the body and head emitted a vivid and greenish phosphorescent gleam, imparting to the creature by its own light, a truly ghastly and terrific appearance. The luminous effect was constant, and not perceptibly increased by agitation or friction. I thought at one time it shone brighter when the fish struggled, but I was not satisfied that such was the fact. When the shark expired (which was not until it had been out of the water more than three hours) the luminous appearance faded entirely from the abdomen, and more gradually from other parts, lingering the longest around the jaws and the fins."

" The only part of the under surface of the animal which was free from luminosity was the black collar around the throat; and while the inferior surface of the pectoral, anal, and caudal fins shone with splendor, the superior surface (including the upper lobe of the tail fin) was in darkness, as, also were the dorsal fins, back, and summit of the head.

I am inclined to believe that the luminous power of this shark resides in a peculiar secretion from the skin. It was my first impression that the fish had accidentally contracted some phosphorescent matter from the sea, or from the net in which it was captured, but the most rigid investigation did not confirm this suspicion, while the uniformity with which the luminous gleam occupied certain portions of the body and fins, its performance during life, and decline and cessation upon the approach and occurrence of death, did not leave a doubt in my mind that it was a vital principle, essential to the economy of the animal. The small size of the fins would appear to denote that this fish is not active in swimming; and, since it is highly predaceous, and evi-

A minute globular cell is typical of the common germ, from which all organic fabrics proceed. All animals (nn) and plants therefore may be justly regarded as definite aggregations of cells, endowed with specific properties in the different types, and subjected to a never-varying law of development; and in animals, as well as in plants, there are certain kinds in which the entire organism consists of but a single cell, whilst others only depend on the peculiar arrangement of the cells.

Professor Huxley has satisfied himself that in all the animal tissue, the so-called nucleus (*endoplast*) n is the homologue of the primordial urticle, with nucleus and contents (endoplast) of the plant; the other histological elements being invariably modifications of the periplastic substances.

The mere aggregation of cells performs all the functions of animals and life, viz., the maintenance of a particular form for a certain period, the elaboration of

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dently of nocturnal habits, we may perhaps indulge in the hypothesis that the phosphorescent power it possesses is of use to attract its prey, upon the same principle as the Polynesian Islanders and others employ torches in night fishing."—(C. F. Holder.)

(nn) Mr. Brandt (*Botan. Zeitung*, 1882, No. 15) has just published some curious researches which, if their results are verified, will prove of considerable importance. According to him, these so-called granules of chlorophyl are algæ parasitic on the animals in question, and, in some cases, he states, he has been enabled to isolate and cultivate them. Generalizing the facts observed, he concludes that we have here a curious association of an animal with a plant. The green algæ is a parasite of worm, hydra, or infusoria; but from another point of view, the converse is true, since, under the action of light, the chlorophyl organisms assimilate carbon of the carbonic acid, and furnish it to the animals in which they are established. Mr. Brandt compares the animals thus provided with these sorts of *gonidia* to a lichen in which the fungus has been replaced by an animal.

(n) The different appearances of various organs of plants principally arise from arrested development. Stamens, pistils, corolla, calyx, and bracts are simply modifications or successive stages of the leaf.

Differences in plants are like differences in man and other animals.

materials of support from food, locomotion, and the perpetuation of the species; hence these animals, like the simplest plants, may be divided without losing their vitality, and every part may become a perfect individual.

"The hydræ is nothing more than a congery of cells, and yet, if the creature is turned inside out, then, that which was the surface of the stomach will become the epidermis, and the outer skin forms the lining of the new stomach, and carries on the process of digestion.—*A. Trembley's Memoires*, 4° Leyde, 1744.

Among the later outgrowths of scientific investigation we find the theory of abyssal light, intended to explain the presence of eyes in many of the deep sea forms, their existence supposed to be conditional upon the presence of light in the greater depths of the ocean. The Ascidians and Alcyonarians are well-known as wondrous light givers. The shape of the former we are most familiar with is the oval ball that seems growing upon a stem, and waves to and fro with the tide like a veritable plant; it is, however, a highly organised animal. Some of the Ascidians are free-swimmers, and live in colonies; such is the Pyrosoma, one of the most remarkable of all phosphorescent creatures, as well as one of the largest. In appearance they resemble an elongated empty barrel, about five feet long as a maximum, with one end closed, the other open, a provision that insures movement in a given direction. The means of propulsion seem incomprehensible, but it is easily explained, however, upon an examination of the animal. Each individual in the colony draws in water from the outside and ejects it into the interior, where it finds a common outlet at the open end, the current rushing out forcing the aggregation of Ascidians along in the direction it happens to take. The surface is completely covered with curious filaments that appear to wave to and fro. Such is the general appearance of the creature in the day time, but in the night or abyssmal depths of the ocean, it presents an entirely different sight, gleaming and glowing with a wondrous golden light, that penetrates the water for twenty or thirty feet around it, and resembling more than anything else a cylinder at white heat, vibrating waves seeming to pass over it in quick succession, producing many different tints of yellow and gold. As may be surmised, at a distance of one hundred feet or more they resemble worms three or four feet in diameter, of wavy nebulous matter, the centre burning brightly. The appearance of numbers of these wondrous creatures in the water is an extraordinary sight, looking down into the depths we seem to be looking into space. Every break of the water is the signal for myriads of beautiful creatures to spring into life,

ANIMAL CELLS.

At the lowest degree of the organic world, we find beings without structure, amorphous; for instance, the genus (o)Amœba, $\frac{1}{1000}$ of an inch in diameter, and many only

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as it were, the sea fairly igniting, the minute granules in the depths below sparkling and scintillating in the reflection. Great constellations seem revolving in erratic courses, now rising and falling, meeting each other, the lights intermingling, while smaller phosphorescent jelly fishes, like stars of lesser magnitude, revolve about them, completing the curious scene. The light given out by the Pyrosoma is not confined to the water, but is reflected above it, covering everything with a pale, ghostly light. The sails of vessels are lighted up by it, and cast dark shadows about, while within four or five feet of the animal a newspaper can be read with perfect ease.

(o) "The study of an amœba, with the help of knowledge gained by an examination of more complex bodies, enables us to state that the undifferentiated protoplasm, of which its body is so largely composed, possesses certain fundamental vital properties:

1. It is Contractile.—There can be little doubt that the changes in the protoplasm of an amœba, which bring about its peculiar "amœboid" movements, are identical in their fundamental nature with those which, occurring in a muscle, cause a contraction; a muscular contraction is essentially a regular amœboid movement, an irregular flow of protoplasm. The body of the amœba may therefore be said to be contractile.

2. It is Irritable and Automatic.—When any disturbance, such as contact with a foreign body, is brought to bear on the amœba at rest, movements result. These are not passive movements, the effects of the push or pull of the disturbing body, and therefore proportionate to the force employed to cause them, but active manifestations of the contractility of the protoplasm; that is to say, the disturbing cause or stimulus sets free a certain amount of energy previously latent in the protoplasm, and the energy set free takes on the form of movement. Any living matter which, when acted on by a stimulus, thus suffers an explosion of energy, is said to be "irritable." The irritability may, as in the amœba, lead to movement; but in some cases no movement follows the application of the stimulus to irritable matter, the energy set free by the explosion taking on some other from (heat, &c.) than movement. Thus a substance may be irritable and yet not contractile, though contractility is the most common manifestation of irritability.

The amœba (except in its prolonged quiescent stage) is rarely at rest. It is almost continually in motion. The movements cannot always be referred to changes in surrounding circum-

stances acting as stimuli; in many cases the energy is set free in consequence of internal changes, and the movements which result are called spontaneous or automatic movements. We may, therefore, speak of the protoplasm of the amœba as being irritable and automatic.

3. It is Receptive and Assimilative.—Certain substances serving as food are received into the body of the amœba, and, being there in large measure dissolved, become part and parcel of the body of the amœba—become, in fact, fresh protoplasm.

4. It is Metabolic and Secretory.—Pari passu with the reception of new material, there is going on an ejection of old material, for the increase of the amœba by the addition of food is not indefinite. In other words, the protoplasm is continually undergoing chemical change (metabolism), room being made for the new protoplasm by the breaking up of the old protoplasm into products which are cast out of the body and got rid of. These products of metabolic action have, in all probability, subsidiary uses. Some of them, for instance, we have reason to think, are of value in the solution and preliminary changes of the raw food mechanically introduced into the body of the amœba; and hence are retained within the protoplasm for some little time. Such products are generally spoken of as "secretions." Others, which pass more rapidly away, are generally called "excretions." The distinction between the two is an unimportant and frequently accidental one. The energy expended in the movements of the amœba is supplied by the chemical changes going on in the protoplasm by the breaking up of bodies possessing much latent energy into bodies possessing less. Thus the metabolic changes which the food undergoes in passing through the protoplasm of the amœba (as distinguished from the undigested stuff mechanically lodged for a while in the body) are of three classes: those preparatory to and culminating in the conversion of the food into protoplasm; those concerned in the discharge of energy; and those tending to economise the immediate products of the second class of changes by rendering them more or less useful for the first.

5. It is Respiratory.—Taken as a whole, the metabolic changes are pre-eminently processes of oxidation. One article of food—i. e., one substance taken into the body, viz., oxygen—stands apart from all the rest; and one product of metabolism peculiarly associated with oxidation—viz., carbonic acid—stands also somewhat apart from all the rest. Hence, the assumption of oxygen and the excretion of carbonic acid, together with such of the metabolic processes as are more especially oxidative, are frequently spoken of together as constituting the respiratory processes.

6. It is Reproductive.—The individual amœba represents a unit. This unit, after a longer or shorter life, being increased in size by the addition of new protoplasm in excess of that which it is continually using up, may by fission (or by other means) re-

just visible with the highest power of about 5000 diameters, and in the genus Monas *(polytonia, difflugia, enchelys):* they are small contractile albuminoid masses, whose forms are modified incessantly;—structurally they are nothing more than a mobile lump of semi-fluid (oo) protoplasm, which digests as perfectly, so far as the result to itself is concerned, as does the most highly organised animal, with the most complex digestive apparatus. Such are also the simplest Rhizopods, to which Amœba belong, living masses rather more considerable, but without definite form,—emit and re-absorb tentaculiform prolongations of varying length.

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solve itself into two (or more) parts, each of which is capable of living as a fresh unit or individual."

(oo) Living Bathybius was first observed, in 1868, by Sir Wyville Thomson and Prof. William Carpenter, two practised and sagacious zoologists, during a deep-sea exploring expedition to the North Atlantic, in the war-ship Porcupine. Of the living deep-sea ooze they write:—"This ooze was actually living; it collected in lumps as though albumen had been mixed with it; and under the microscope the sticky mass was seen to be living sarcode."—"(Annals and Magazine of Natural History," 1869, vol. iv., p. 151); and Sir Wyville Thomson, in his very interesting work, "The Depths of the Sea," second edition, 1874, p. 410, adds :

"In this dredging (Globigerina-ooze taken at the depth of 2,435 fathoms in the Bay of Biscay), as in most others in the bed of the Atlantic, there was evidence of a considerable quantity of soft gelatinous organic matter, enough to give a slight viscosity to the mud of the surface layer. If the mud be shaken with weak spirits of wine, fine flakes separate like coagulated mucus; and if a little of the mud in which this viscid condition is most marked be placed in a drop of sea-water under the microscope, we can usually see, after a time, an irregular net-work of matter resembling white-of-egg, distinguishable by its maintaining its outline, and not mixing with the water. This net-work may be seen gradually altering in form, and entangled granules and foreign bodies change their relative positions. The gelatinous matter is therefore capable of a certain amount of movement, and there can be no doubt that it manifests the phenomena of a very simple form of life."

"With respect to dead Bathybius—deep-sea ooze brought from the North Atlantic and preserved in spirits of wine—all the observers who have studied it closely agree in saying that it

The Telerpeton Elginense is the most ancient unquestionable relic of its class; their organisation is analogons to that of the simplest condition of the vegetable kingdom, the cellulose; for even the large Fuci, or sea-weeds, consist only of cells.

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contains greater or smaller masses of coagulated protoplasm, which, in their morphological and chemico-physical properties, bear the closest resemblance to certain Moneres. The results obtained by Huxley from material examined by him—results which I myself have been able to confirm and enlarge—have been admitted as correct by all the other observers who studied the same ooze."

"With respect to living Bathybius, we have positive testimony as to its characteristic Rhizopod-like movements from three competent observers, namely, Sir Wyville Thomson, Prof. William Carpenter, and Dr. Emil Bessels. All three made their observations on deep-sea ooze from the North Atlantic."—HÆCKEL.

The well-known North-Polar explorer, Dr. Emil Bessels, who fortunately returned safe after the wreck of the "Polaris," writes as follows of the Haeckelina gigantea, a giant Rhizopod, probably identical with Astrorhiza, previously described by Sandahl:—

"During the late American North-Polar Expedition, I found in Smith Sound, at the depth of ninety-two fathoms, great masses of free, undifferentiated, homogeneous protoplasm, without any trace of coccoliths. In view of its truly Spartan simplicity, I gave to this organism (which I was able to study in the living state) the name of Protobathybius. In the report of the expedition it will be figured and described. I would simply say in this place that these masses consisted of pnre protoplasm, in which calcareous particles occurred only by accident. They appeared to be very sticky, mesh-like structures, with perfect amœboid movements; they took up particles of carmine, and other foreign substances, and there was active motion of the nuclei."—[Jenaische Zeitschrift fur Naturwissenschaft, vol. ix., p. 277. See also Annual Report of the Secretary of the Navy (U.S.) for 1873].

"Among the simpler organisms known to biologists, perhaps the most simple as well as the most common is that which has received the name of Amœba. There are many varieties of amœba, and probably many of the forms which have been described are, n reality, merely amœbiform phases in the lives of certain animals or plants; but they all possess the same general characters. Closely resembling the white corpuscles of vertebrate blood, they are wholly or almost wholly composed of undifferentiated protoplasm, in the midst of which lies a nucleus, though this is sometimes absent. In many a distinction may be observed between a more solid external layer, or *ectosarc*, and a more fluid granular

Fresh water confervæ are merely jointed films composed of cells, containing granules or lesser cells. In the above examples, as well as in common mould, *Leparia nivalis* and the *Tortula Cerevisiæ*, all the functions of vegetable life, viz., absorption, assimilation, the fixation of carbon from the atmosphere, respiration, exhalation, secretion, and reproduction can be effected by one single cell.

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interior, or *endosarc;* but in others even this primary differentiation is wanting. By means of a continually occurring flux of its protoplasmic substance, the amœba is enabled from moment to moment not only to change its form, but also to shift its position. By flowing round the substances which it meets, it, in a way, swallows them ; and, having digested and absorbed such parts as are suitable for food, ejects or rather flows away from the useless remnants. It thus lives, moves, eats, grows, and after a time dies, having been during its whole life hardly anything more than a minute lump of protoplasm. The simple automatism of the amœba, with its simple responses to external stimuli, is replaced in the higher animals by an exceedingly complex volition, affected in multitudinous ways by influences from the world without; and there is a correspondingly complex central nervous system. And here we meet with a new form of differentiation unknown elsewhere. While the contractility of the amœbal protoplasm differs at the most but slightly from the contractility of the vertebrate striated muscle, there is an enormous difference between the simple irritability of the amœba and the complex action of the vertebrate nervous system. Excepting the nervous or irritable tissues, the fundamental tissues have in all animals exactly the same properties, being, it is true, more acute and perfect in one than in another, but remaining fundamentally the same. The elementary muscular fibre of a mammal is, at most, a mass of but slightly differentiated protoplasm, forming a whole physiologically continuous, and in no way constituting a mechanism. Each fibre is a counterpart of all others ; and the muscle of one animal differs from that of another in such particulars only as are wholly subordinate. In the nervous tissues of the higher animal, on the contrary, we find properties unknown to those of the lower ones; and, in proportion as we ascend the scale, we observe an increasing differentiation of the nervous system."

Ten years ago Mr. Dollinger determined to work out, by actual microscopic observation, the life-history of some of the lowly and minute organisms which occur in putrid infusions. After four years of preparation, he commenced his work in conjunction with Dr. Drysdale, the plan needing two observers. Each set of observations was made continuous, so that nothing

should have to be inferred. Very high powers were employed, and the largest adult objects examined were 1,000th of an inch, the smallest 4,000th. Six forms altogether were selected, and their whole history was worked out. At first it was supposed that reproduction by fission was the usual method, but prolonged research showed that spores were produced. Those were so small that a magnifying power of 5,000 diameters was needed to see them as they began to grow. The glairy fluid from which they developed seemed at first homogeneous, and it was only when growth set in that the spores became visible. All that could be learned about the origin of the glairy fluid was that a monad larger than usual, and with a granulated aspect toward the flagellate end, would seize on one in the ordinary condition; the two would swim about together till the larger absorbed the smaller, and the two were fused together. A motionless spheroidal glossy speck was then all that could be seen. This speck was found to be a sac, and, after remaining still from ten to thirty-six hours, it burst, and the glairy fluid flowed out. The young spores that came into view in this were watched through to the adult condition. Bearing on the subject of spontaneous generation, this fact was learned, that, while a temperature of 140 deg. Fahr. was sufficient to cause the death of adults, the spores were able to grow even after having been heated to 300 deg. Fahr. for ten minutes.—Vide "Report to Royal Instit. of Great Britain."

Dr. Bastian, in a communication to the Royal Society of London, last June, cited some experiments to show that, while an acid urine usually remains barren after being boiled a few minutes, it becomes fertile when similarly treated if previously neutralised by liquor potassæ, especially if it be afterwards maintained at a temperature of 115 deg. or 120 deg. Fahr. But the significance of these results for the doctrine of spontaneous generation is proved to be very little indeed by Dr. William Roberts and Prof. Tyndall, both of whom show that Bastian's experiments only confirm the observation made by Pasteur more than fourteen years ago, that alkaline liquids are more difficult to sterilise than acid ones. They further show that such liquids, once effectually sterilised, according to methods which they describe, remain perfectly sterile when the access of life-germs from without is precluded. The addition of the alkali appears to enable the preexisting germs in the urine to survive the process of ebullition. To prevent this conservative action of the liquor potassæ, and at the same time to have a mixture precisely the same as that experimented on by Bastian, Tyndall adopted the following mode of procedure, which is substantially identical with that adopted by Dr. Roberts: Small tubes, with their ends finely drawn out, were charged with a definite amount of caustic potash, and subjected for a quarter of an hour to a temperature of 220 deg.

The aggregation of simple cells (ooo) forms the cellular tissue, a fusion or blending of several cells produces the vessels and so forth ; and by cells are elaborated the gum, resin, oil, starch, and gluten, &c.; and by cells specially endowed are secreted the narcotic property of the poppy, the deadly poison of the night-shade, and the aroma of the clove, lemon, and rose.

In animal structure, all the various processes of vitality are performed by cells or globules, varying in size from an infinite minuteness to forms visible to the unassisted eye.

Animal nucleated cells are more or less of a globular form ; size of cell is 300th of an inch in diameter ; the nucleus $\frac{1}{3,000}$, the nucleolus $\frac{1}{10,000}$ of an inch in diameter.

One system of cells secretes bile, another adipose matter, another the nervous matter, &c., but how formed we know not.

FORM OF CELLS.

Professor Carus (1835) demonstrated that animal bodies in their primary form were spherical. He instanced the globules of water, mercury, blood, the heavenly bodies, and globular infusoria. A contraction of this sphere, a conversion of it indeed into bodies terminated by straight lines, as dodecahedrons and hexahedrons, expresses the suspension or death of the interior vital action, and determines the formation of inorganic matter, and of mineral or crys-

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Fahr. They were then introduced into flasks containing measured quantities of urine. The urine being boiled for five minutes, the flasks were hermetically sealed during ebullition. They were subsequently permitted to remain in a warm place, sufficiently long to prove that the urine had been perfectly sterilised by the boiling. The flasks were then rudely shaken, so as to break the capillary ends of the potash-tubes and permit the liquor potassæ to mingle with the slightly acid-liquid. The urine thus neutralised was subsequently exposed to a constant temperature of 122 deg. Fahr., which is pronounced by Dr. Bastian to be specially potent as regards the generation of organisms.

(ooo) There are among the seaweeds, or algæ, plants consisting of one cell, which cell constitutes the entire plant, a true individual, and performs all the essential functions of vegetation.

talline bodies. An expansion of this sphere, an enlargement of it externally, or a multiplication of its centre, or periphery, expresses an increase of the individual vital action, and determines the formation of organic matter, or of individual living beings, be they animal or vegetable.

The next point to be observed is that the primary mass of all organised matter is fluid; for man and many of the inferior animals begin their career of development by an albuminous globule or ovule, $\frac{1}{125}$ of an inch in diameter.[p]

It may be considered as a fundamental law, that all organised bodies begin their career by the most simple form (the sphere), and that their development or evolution [(pp)] results from differences which are themselves occasioned by the multiplication or repetition of the primary unit, or sphere.

This cell is an apparatus worked and kept in operation by means of the same space-traversing lineits of the universal medium, and the same three ultimate primitive powers, viz., *Versatile Activity, Endunition,* and *Synduction*—that sustain and move all the nervous system; in fact, the machinery of the universe itself.

Now, if in the great concave sphere, the universe of all material and immaterial things, we recognize the *macrocosm*, so in the minute living, organic active *cell* we recognize the *microcosm*. Because, what the *cosmo-velo* is to the former, the enveloping *cellulose* is to the cell; what the cosmic-core of the universe is to the universe, the *nucleus* (or *cytoblast*) is to the cell; and equally well do the *currents* that traverse the cell in various directions (in fact, electricity pervades both space and matter, inorganic or organic), and which appear to radiate from and return to the nucleus, and are not at all influenced in their movements by other cells from without, represent in minature the system of streaming cosmolinæ ot the great universe.

Thus the *cytoblast*, the *cellulose*, and the currents of the cell, together make up the *microcosmic soul*, just as the convolution, the cosmo-velo, and the cosmolinæ, constitute the macrocosmic soul of the universe.

(p) The ovule being the seed of the male, and the germ-bed being the female.

(pp) Mr. Herbert Spencer made evolution the fundamental principle of philosophy, and regarded dissolution, which is its exact opposite and correlate, as practically of very inferior im-

The forms resulting from a modification of the sphere are the double cone and the cylinder, *i.e.*, the superficial contents contained in one sphere of given dimensions is precisely equal to that contained in one double cone of certain dimensions, so that one form may resolve itself into the other without the slightest excess or redundancy of

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portance. For, so far as the earth itself and the heavenly bodies are concerned, the very existence of such a process is in doubt. So far as our knowledge of the universe, as such, extends, but one law is anywhere observable, and that is the law of evolution. Indeed, evolution is but the process of which the principle is gravitation. Evolution is the concentration and integration of matter; its tendency is toward the condition of stable equilibrium. The *con*traction of a body is due to the *at*traction or concentration of its molecules. Gravitation alone can explain this tendency, and gravitation necessarily requires it. Evolution is therefore co-extensive with gravitation. Wherever gravitation prevails, evolution must prevail. On the contrary, a condition of dissolution would require the prevalence of a force the reverse of gravitation—a repulsive and expansive force. Our acquaintance with the visible universe reveals no region of space where we can assume the prevalence of such a force. On the contrary, many fixed stars, and even nebulæ, afford the strongest evidence of being under the dominion of an attractive force. Not, however, but that there exists in the universe abundant evidence of the possibility and reality of a repulsive or dissolving force. This is found, and with the greatest certainty, within the scope of our daily observation of the facts about us. And in at least one instance it is assumed, with a high degree of proof, to manifest itself in regions beyond the limits of terrestrial influence. I refer to the behavior of the tails of comets at perihelion. But wherever we see this force of repulsion, which alone could effect the dissolution of the aggregates already formed, it is wholly subordinate to the force of attraction which has formed them. Phenomena of this nature are but episodes in the history of a system or of a world. Everywhere the opposite phenomena predominates. Everywhere the force of gravity is evolving new aggregates, and bearing old ones on to their final state of complete equilibration.

Let us now turn to the second branch of our subject, and glance for a moment at the phenomena and laws of organic evolution. The first fact that presents itself is, that its primary condition is the influence of the sun. However it may have been at one period of the history of the earth, when its internal temperature may have been of a nature to favor the development of organic life without the sun's aid, by the earth becoming itself a sort of sun, it may at least be now affirmed that the solar radia-

matter, merely by the difference of the internal elastic force. Geometry proves this; and it may be stated, without hesitation, that the primary forms of all the solid parts of the animal body are absolutely those of the double cone and cylinder under certain modifications. The first form produced by the multiplicaton of the centre, and of the surface of the sphere, is a series of segments of spheres interlaced one within another, analogous to the segments of the Articulata, and which would be produced by developing other spheres of the same size on the central axis of the primary one, each having, of course, a new and particular centre.

The second form is that where new spheres are developed, as just described, but are either of greater or less size than the generative sphere, giving origin to an ellipse, or a cylinder terminated at each end by a hemisphere. These spheres being considered as hollow ones, united so that all mark of separation is removed, there can then remain from all the medium ones but a middle zone, a ring only visible on the exterior, whose place is determined by the point where one hollow sphere interlaces with another; each sphere, then, would have the form of a ring.

These forms of hollow spheres, ellipses, rings, &c., are the true prototypes of many of the softer parts of the animal body, as the viscera, the nervous ganglions, &c.

These simple forms may be seen in the rays of the Asterias;—and the segments of the Articulata are a series of hollow rings; in Vertebrata there are segments of the

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tions are the sole condition of vital existence on the globe. This fact is so apparent and recognized that science has scarcely been able to qualify the popular conception. By the aid of the sun's heat and light the various forms of vegetable and animal life have been evolved. By the same influence, year by year, buds, flowers, and leaves unfold to the elements, and renew their conditions of growth and reproduction. By means of it the waters of the globe are in part converted into vapor and gas, in which state alone they are adapted to the supply of organic beings. By its influence the various organic bodies on the surface of the earth are finally disintegrated, and the materials for new forms and new beings are dissipated into the gaseous form, for recomposition and reutilization. By the same influence the waters of the globe

body, and there each ring (compacted together as a whole), would be formed of a vertebræ, two ribs with their cartilage, and a portion of the sternum.

The human cranium offers another example, being composed of a certain number of vertebræ, formed as segments of a hollow sphere from the simple vesicle, by which the brain, as well as the cranium itself, begins its career of improvement. This simple column of primary spheres may change the direction of its axis, and continue to be developed in three directions at once. The multiplication of the sphere may also proceed from the periphery; secondary and tertiary spheres may also be developed, subject to a variety of modifications, and regulated in their development by strict geometrical principles.

MAN AS A MONAD.

Man, the essence and perfection of organic and animal life, and at the same time his own star, (q) and the soul that can—

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are prevented from solidifying, and remain the abode of millions of organic beings. In a word, it is the influence of the sun which alone renders our planet a habitable globe.

"But what is the nature of this great and wonderful influence as expressed in the terms of the redistribution of matter? The great life-creating and life-sustaining force of the sun is cosmologically a *disintegrating* force, a force of *dissolution*. Indeed, the solar and sideral radiations are the only examples which the whole universe presents to us of such a force. It seems strange enough to be compelled to ascribe all the phenomena which have been embodied in the term organic evolution to the action of a force which is the precise opposite of evolution, and which ultimately accomplishes the dissolution of every such aggregate. Yet it is only because the sun is in a state in which its matter is being integrated, and its motion radiated into space, that our earth is capable of producing the forms of organic life. It is only because a portion of this motion, ejected from the sun, is intercepted and absorbed by the earth, by which a portion of its own matter is disintegrated, and its own course of evolution is in so far arrested that the presence of the beings peopling it has been made possible. It is only through cosmical dissolution that organic evolution can go on."

(q) Man first commenced his career as a monad.—LAMARCK.

"Render an honest and a perfect man,
Command all light, all influence, all fate,—
Nothing to him falls early, or too late;
Our acts our angels are, or good or ill,
Our fatal shadows that walk by us still."

must have a like beginning as the monad, [qq] or the particle of matter which expands by heat and contracts with cold: there must be a time when he exists only as a globule of elementary matter—or he is first formed in a liquid state, or undefined fluid or plasm; and it is only in the special chemico-physical properties of carbon, and especially in the semi-fluidity and instability of the carbonised albuminoidal compounds, that we must seek the mechanical causes of the phenomena of particular movements, by which organisms and inorganisms are differentiated, and which may be called, in a more restricted sense, life or vitality.

Man, and other superior animals, at the outset of their embryological existence, commence by being monocellular, then pass through the polycellular state, the most rudimentary; finally, in a last period, their histological elements differentiate. This gradual histological differentiation, which is observed in the embryological development of superior beings, can also be demonstrated in the palæontological succession of the organised beings on our globe. In fine, it is easy to encounter it anew, by grouping living beings hierarchically, from the simplest to the most complex.

*Man may be said to appear first as a mere speck, or diminutive floating atom, then a shapeless jelly, then a soft homogeneous substance, size of a barley-corn, a rude form,

(qq) "As in physical nature matter has its laws, so in spiritual and moral nature the laws of mind are inexorable. That the reaping shall follow upon the sowing is both the bane and support of human action. We are not gods, with a power of creation, neither are we the playthings of a blind chance. With open eyes man moulds his destiny, from his birth to his death."—*Spectator*.

* The conception of man descending from inferior life, is by the ignorant mass considered degrading to man's dignity; it is, however, only a matter of feeling or sentiment. We can show man not to be any the less human because his origin is shown to be derivative. Mother Nature never concerns herself in her dealings

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then finally a regularly organised form, hard and soft, and in part fluid. He may be considered as placed at the positive end of a magnetic pole, at the negative end an animated or microscopic point, of which thousands are found in a single drop of fluid. Numberless gradations are placed between these; so that, though the extremes are immeasurably wide, or remote, there is close approximation between any two links.

In referring back again to the monad, I may state, that with an animal its development is arrested after a certain stage, whilst the development of man proceeds rapidly on in his career, and arrives at last at what is conceived to be the type and essence of animal perfection, and even then—

> "Men are so near the primitive making, they retain
> A sense of nothing but the Earth; their brains
> And barren heads standing as much in want
> Of ploughing as their ground. To hear a fellow
> Make himself merry and his horse with whistling
> Sellinger's round; t'observe with what solemnity
> They keep their wakes, and throw for pewter candlesticks,
> How they become the morris! with whose bells
> They ring all into Whitsun-ales and swear
> Through twenty scarfs and napkins, till the hobby-horse
> Tire, and the Maid Marion, dissolved to a jelly,
> Be kept for spoon-meat."—(SHIRLEY).

The development in one case is produced by a culture and soil, or germ-bed, which, being in a high state of perfection, perfects the animal, while in the other that germ-

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as to man's dignity. Dissent from the general doctrine of evolution can only arise either from ignorance of some special department of science, or from a bias of feeling against the doctrine. The greatest probability is in favor of development, and Bishop Butler aptly remarks that, "probability is the guide of life." Sir W. Hamilton says, "The Law of Logic is the law of parismony," or the law which forbids us to assume the operation of higher causes when lower ones are found sufficient to explain the observed effects; this law constitutes the only logical barrier between science and superstition. Finally, I may say, if man is able to come and become, by evolution from cells or molecules, why should not consciousness come and become by evolution from undulations. If we have evolution upwards from a molecule to man, there should also be degeneration downwards.

bed is lacking, or peculiarly modified, hence arrested development.

Even in the highest animals, a large portion of their tissues consists only of an aggregation of cells, as in the epithelial and glandular tissues; each individual cell being, in its function, a complete epitome of the whole tissue or organ. In fact, all the organic or vegetative functions of living beings are performed by the agency of cells. The cell doctrine is generally attributed to Schleiden and Schwann (1838), but Schwann was not aware of cell-division. The first who saw such a process in the blood-corpuscles of embryos was Remak. Cell-multiplication has been found by Günsburg and Breuer.—Vide *Breuer, Melet, cir. Evol. ac. from Cicat, Vratisl*, 1843, *p.* 31). The former first applied cell-doctrine to vegetables, the latter to animals. Raspail had, however, previously announced that the origin of both vegetables and animals was identical, viz., in a vesicle or cell.

When organised beings are, as above stated, formed from cells, they live as they can, become what circumstances [r] (sub-commanders of nature) permit them to become, and all processes are good to what I call nature, provided they attain their object. Thus the hydrarian polypi live in colonies, and never separate until the death of the parent.

With the Syphonophores there is a division into castes, each having its proper functions to perform. With the Medusæ, actinia, bryozoaries, &c., &c., there is a peculiar and different organisation of adaptation to certain ends; and even with Man, he is a creature of circumstance: all his actions and aim is to carry out certain ends according to his means and surroundings, and yet his "bane and antidote" are both before him.

> "This is misery; the last the worst,
> That man can feel; man fated to be cursed."
>
> "A combination and a form, indeed,
> Where every *god* did set his seal,
> To give the world assurance of a man."

(r) "The very air we breathe is absolutely teeming with germs, and we are surrounded on all sides by an innumerable

MAN.

"Man is only a more complicated and variously-endowed automaton than other animals, and the succession of his mental state depends entirely upon the molecular activity of his cerebrum; and the movements he is accustomed to regard as expressing his feelings, or as executing his intentions, have their real origin in brain-changes, of which those feelings and intentions are the mere concomitant symbols in consciousness."—(Carpenter).

Again, all mental as well as bodily activity, being the outcome of the "potentialities" of matter, are subject to physical conditions alone. And it is an illusion of ignorant "common sense" to say that man has freedom of choice (within certain limits) as to his different modes of action. And the only point regarding the action of a frog, when the cerebrum is removed, is that a "provision exists in the inherited structure of the frog for doing that which Man only learns to do by intentional training."

For he is a creature of circumstances, he alone is *cosmopolitan*, for he only is acquainted with the use of fire and clothing. He appreciates and seeks for causes. He observes the actual, conceives the possible, and doubts the supernatural. And when his perceptive faculties are baffled, he dreams, when they compass their object, he enquires after cause. He cares for neither frost or fire, so long as he can get good food for his mouth and fit clothing for his limbs. And being armed with reason and clad with understanding, he is able to be master of the situation in every zone, he can endure all climates, undertake all labors, overcome all trials, casting nets in the Bay of Fundy, circling the north and south poles, cradling gold in the Sacramento vallies, quartz-crushing and tin washing in Tasmania, sheep tending or kangaroo hunting in Australia, diamond washing at the Cape or Brazil, and raising

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array of minute organic beings. They appear to be at incessant warfare amongst themselves, and we are the prey, or form the spoil of the stronger party. It is evident, however, that we are at the mercy of a world of creatures of which we know, as little of them as we do of the inhabitants of the planet Mars."—Dr. Angus Smith on "Air and Rain."

dates or lemons in Florida or New Guinea. Again he is found trapping beavers in Oregon and Canada, hunting wild boars and wolves in Russia and Germany, trading with opium and tea in India and China, raising herds of kine in Texas and Illinois, hunting buffaloes on the Western prairies, spinning threads in Massachusetts or Manchester, clearing woods in Canada and New Zealand, smelting iron in Pennsylvania and Wales, digging salt in Siberia, tunnelling the Alps, channelling the African desert, climbing Antartic glaciers, sounding the depths of the Ocean, talking politics in British Columbia, waging war on the Asiatic steppes, and exploring the centre of African savage life. He is the man of plastic genius, of indomitable and enduring character, a citizen of the world, a cosmopolitan by birth, equally at home among the palm-trees and the pines, in every latitude, the guide, the employer, and the sovereign king of animal life.

END OF PART I.

J. J. Miller, Printer, 72 Little Collins-street East, Melbourne.